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The Manufacture of Household Appliances

By J. V. HUNTER
Western Editor, *American Machinist*

The necessity for the reduction of the labor required to keep up the modern home has lately caused an increased demand for the numerous labor-saving machines that have been developed. One of the large manufacturers in this line has built a modern plant for the production of such machines, and the methods there employed are described in the following article.

AMONG the arduous duties in the modern household are washing, ironing, and the necessary sweeping away of the daily accumulations of dust. The reduction of this work to a minimum has lately attracted so much attention that large manufacturing plants have sprung up throughout the country for the production

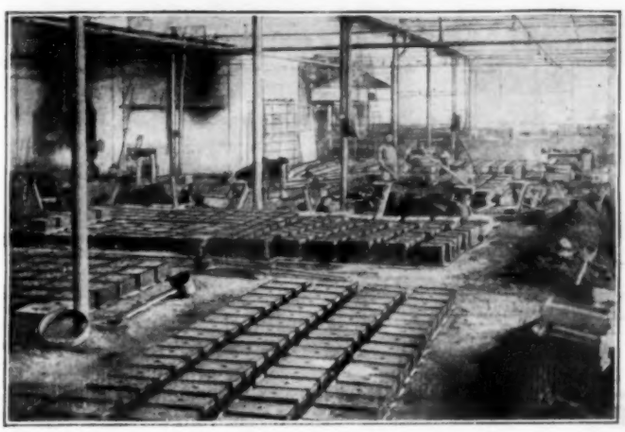

FIG. 1. ONE BAY OF THE MODERN FOUNDRY

of household labor-saving machines. The Hurley Machine Co., Chicago, Ill., has built up a large factory devoted to supplying the demands for household appliances. This factory is an almost complete manufacturing unit, as its activities extend from the gray-iron foundry through all departments of machine, woodworking and assembling shops to the final inspection and shipping.

The Foundry

A portion of the foundry floor is shown in Fig. 1, and illustrates its modern character and the excellent lighting and ventilating facilities. Note the absence of objectionable smoke or fog, although the picture was taken while the afternoon heat was being poured off.

The cupola is tapped directly into truck ladles and by these the iron may be transported to all portions of the foundry over light steel rails laid almost flush with the floor. At the present, daily heats of about 20 tons are taken off. Most of the pouring off is done by hand ladles, as the majority of the work is light, and requires quick pouring and a very fluid iron.

The molding of much of the work is done on air squeezers. These are supplemented in some cases by the use of the jolt-squeezer type of molding machine on which match-plate patterns are usually employed. The heavier parts, such as legs for washing and ironing machines, require larger molds and roll-over molding machines have been provided for this work. Stripping-plate molding machines have also been provided for some of the castings.

Considerable bench molding is still done in the shop and the type of bench used is shown in Fig. 2. This bench is provided with shelves and extension arms so that everything used by the molder will be in the most convenient position to reach. The shelf at the left is usually occupied with the riddles (now resting on the working portion) and the shelf at the right gives the molder a space where he can place the cope when it is lifted off the drag. The strike-off bar is lying on a little shelf *A* on the front of the upright portion, and the top shelf of this same portion carries the rammers and small tools. It will be noted that the bench is made of ample width to straddle the pile of molding

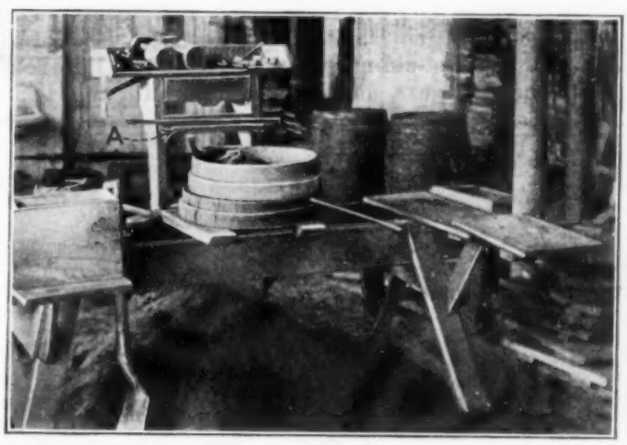

FIG. 2. A MOLDING BENCH PLANNED FOR EFFICIENCY

sand, so that it may be pushed back as the sand pile is used up.

Most of the cores are light, and a partial view of the core room, Fig. 3, shows the type of benches and ovens provided for this work, and gives a general idea of the character of cores made. Split coreboxes of the gang type, producing from four to six cores at a single ramming, are in general use. Most of the cores are baked standing on end, and are placed on the plates in staggered rows for mutual support.

The cleaning room is equal in efficiency, lighting, and

FIG. 3. PORTION OF CORE ROOM AND OVENS

cleanliness with the remainder of the foundry. Rattlers are used almost exclusively for removing the sand from the castings, and are provided with exhaust equipment which keeps the dust from the cleaning room. A large bank of grinding wheels is provided and from these the operators pass the castings directly into sorting bins, each of which is mounted on truck wheels, and as fast as these are filled they can be pushed into the casting-storage room.

No very large stock of castings is carried on hand, as the whole factory is run on an efficient production-scheduling system, which permits the foundry to know, a few days in advance, the castings that will be required by the machine shop, so that they can get their production started as required.

Attention has been given in all the shops to the best possible working conditions, and this is noticeable throughout the machine shop where many provisions have been made for the welfare of the workers. These shops are at present employing quite a number of women workers, and for these ample rest rooms with noon-hour recreation facilities have been provided, also a hospital and first-aid nurse. A cafeteria was installed during the past year, and in connection with this is a large dining room with clean neat tables where all workers, including those who bring their own lunch, may go during the noon hour. There is also a laundry with several attendants who daily wash and iron all of the table linen and all the towels which are in use throughout the plant.

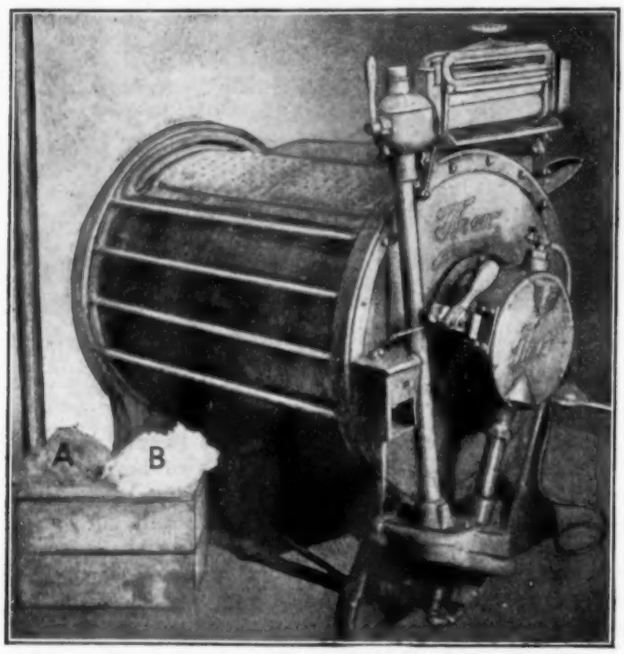

FIG. 4. MACHINE USED FOR WASHING COTTON WASTE

An institutional type of Hurley washing machine has been installed in the boiler room, and to this all cotton waste from the shop is taken and so thoroughly washed that it comes back satisfactory for re-use. Fig. 4 shows this machine together with samples of dirty waste *A* and cleaned waste *B* after it has been subjected to the washing process in this machine. A special soap solution in hot water is used for this washing, and, after rinsing, the waste is passed through the wringer and hung in a special drying room. All paint, dirt, and even chips of metal are removed by the washing.

The scheduling of the work through the machine shop has been done in a thoroughly progressive manner by modern production methods, and all is planned to insure that even where the machine capacity may be somewhat limited, no hold-up in production will be occasioned by a shortage of material. For routing work, production-schedule boards are employed which are located right in the shop so that they will be constantly convenient for observation by the foreman.

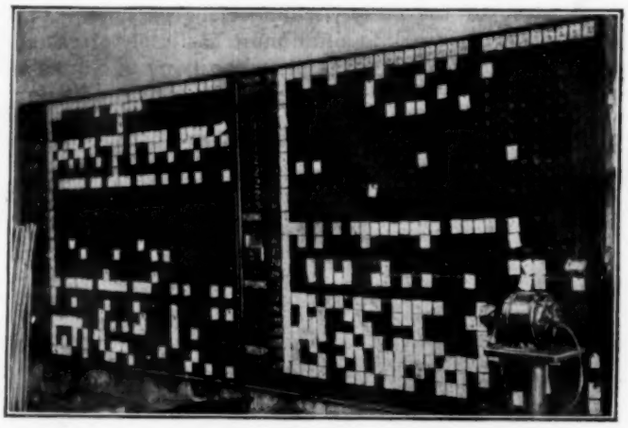

FIG. 5. PRODUCTION SCHEDULE BOARD IN MACHINE SHOP

The Schedule Board

One of the schedule boards is shown, Fig. 5, and on this, each machine is listed in the column at the left of the ruled space where each square represents a day's production. These boards carry the production outline for each machine for a period extending over approximately one month in advance of the present day's work. At the top of these squares small brads have been driven, upon which are hung the square white tags shown in the illustration. On these is written the part-name, job number, and the quantity of parts to be produced by that machine. Where the machine will be engaged on any particular job for a number of days, it is unnecessary to write cards for each one of these days, and instead small brass washers (which might be called ditto marks) are hung in each one of the following squares, representing the necessary number of days' production to complete the job. To prevent the tags from being blown from the brads, rubber bands are stretched over four to five brads at a time.

Machining Aluminum Pistons

By P. T. LENNON
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In machining aluminum where both accuracy and good finish are required it is necessary that the machine used should have no lost motion, the work must be held tightly and yet not be sprung, and the tools must be properly ground. The most approved methods of machining aluminum pistons are given herein by a man who has had a large experience in this class of work.

IT IS interesting to note the attitude sometimes taken, not only by the men, but even by the foremen in many machine shops and service stations, toward the machining of aluminum parts and particularly of lynite pistons. Despite the fact that the machining of aluminum is steadily becoming a larger feature in the daily grind, it does not seem to have received as much attention as regards a common knowledge of cutting speeds, feeds, shape of tools and lubrication, as has been devoted to the machining of other metals.

This impression has been recently strengthened by hearing a foreman, when handing a lynite casting to the machinist, warn him to "be very careful, the stuff tears easy, and there are no extra castings. So go slow and take no chances."

Accordingly, the machinist takes the job knowing that he can afford to cut and try and experiment a little and when finally, he does get down to where the cuts should leave a good smooth, clean and true finish, he gets scared of that "digging in" that occurred in his earlier trials, and allows, as on cast iron, for generous application of a file and abrasive cloth. The result is not always what is should be, particularly if there is a depression cast around the wrist-pin hole where the file will rise and fall on the surface, and will not only pick up particles that will scratch, but will produce irregularities which will show up in the wear of the piston.

It is because the foregoing practice is peculiarly pernicious in the production of lynite pistons, and because pistons generally present some very interesting problems in tooling, that I venture to present the methods that have been found by extended experience to be fairly satisfactory in our own shops. I sincerely hope that this experience may elicit an exchange of ideas and suggestions from wide-awake contributors.

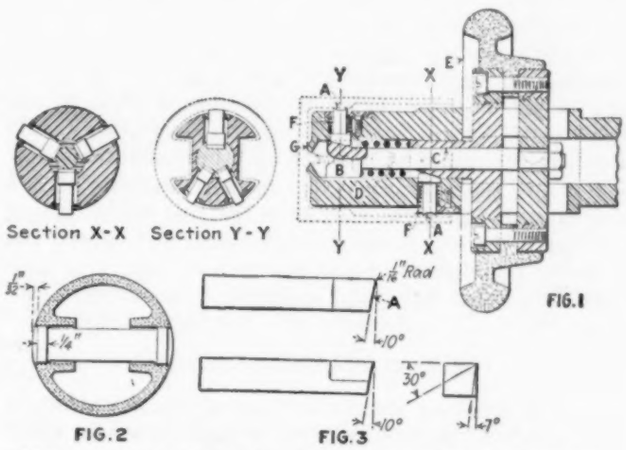
Inside of Piston Should Be True and Concentric With Outside

It is, of course, of prime importance that a piston be machined so that the entire inside is quite true and concentric with the outside. This can hardly be over emphasized. This condition is usually established in the first operation, namely that of squaring the end of the skirt and boring the register seat. To perform this operation, some makers merely grasp the head in an ordinary 3- or 4-jaw chuck (which seldom runs within $\frac{1}{64}$ in. of true), and true the end of the skirt by the introduction of a cone center. The result frequently is, that while the skirt looks all right, the head is badly out of balance. One section under the ring grooves is dangerously thin and its opposite diameter proportionately heavy.

This unsatisfactory condition may be avoided by using a somewhat familiar type of arbor with adjusting pins, as shown in Fig. 1. The six adjusting pins *A* are actuated by tapered seats on the sliding spindle *B* and sleeve *C* each of which has projections passing through slots in the body *D*. These projections are threaded right and left hand respectively to engage with nuts shown inserted in handwheel *E*, thus conveying a telescopic action to spindle *B* and sleeve *C*. The adjusting pins are kept in contact with and returned to their lowest position by springs *F*.

The Operation Is Usually Performed in a Turret Lathe

As the operation is usually performed in a turret lathe, this arbor is held in the turret and projects as little as possible. The piston is slipped on this arbor until the underside of the head comes against the stop



FIGS. 1 TO 3. TRUING ARBOR AND TOOLS USED IN MACHINING ALUMINUM PISTONS

Fig. 1—Arbor for truing pistons. Fig. 2—Pin for holding pistons against register plate. Fig. 3—Tool for turning pistons.

G. The stop should be slotted to clear in the case of a cross rib in piston head. The pins are then expanded to hold the piston rigidly by means of handwheel *E*, and the work is carried forward to a floating chuck which grasps it by the head and which in turn is secured to the back plate before the expanding pins are released.

After the arbor is withdrawn, the inside edge of the skirt should be chamfered deep enough to allow about $\frac{1}{32}$ in. to remain after finishing the end of the skirt and register seat. Next, a cone center is brought forward as a support while a roughing cut is taken almost to the chuck jaws. This allows from 0.01 to 0.015 in. for a finish cut. Then the cone center is withdrawn and the end of the skirt squared to length with rough and finishing cross slide tools. Finally the register seat is bored very carefully to size with rough and finishing turret tools.

One of our sales engineers once asked why a rough cut is taken off the diameter at this early stage in the proceedings. He protested that most of his customers

did this later on when the piston was mounted on its register ring. The principal reason for taking the roughing cut at this stage of the work is that the throwing of a bad burr to the edge of the register seat which might affect later operations is avoided.

Although some shops, and especially those which hold pistons with pins in the wrist-pin hole cores, do not bore these holes until the pistons are nearer completion, it is preferred to make this the second operation for the following reasons: Boring the wrist-pin hole at this time permits the use of the largest cross pin possible to draw the piston against the register plate, and it lessens the danger of the cross pin bearing on the inside ends of the bosses, as the cored hole usually has considerable taper. It is found that when this happens, and especially if the register seat is a sloppy fit on the plate, the piston will be pulled considerably out of round.

As a further precaution, the cross pin should be relieved to within $\frac{1}{2}$ in. of each end and its length be made to within $\frac{1}{16}$ in. of the finished diameter of the piston or to within $\frac{3}{32}$ in. of projecting through each end of the hole. See Fig. 2.

If the wrist-pin hole is machined in a jig, the boring tools should be piloted at both ends, and they should be boring tools, not a drill and machine reamer, as there is apt to be enough freedom in the bushings and wear on the drill to allow it to run off and the reamer will follow the drill to some extent.

If the operation is done on a turret lathe, as is quite common, at least two roughing cuts and one finishing cut should be taken, bringing the hole to from within 0.003 to 0.006 in. of final reaming size. In no case should it be finish-reamed until after all other operations.

Some people are inconsistent in their handling of this operation inasmuch as they bore the hole while resting the rough turned piston in a V-block, and ignore the accurate register seat which presents the only true base from which the hole may be bored with any certainty of its being true and square with the finished surface.

A Good Finishing Reamer

A good finishing reamer has wide flutes cut about 12 deg. left-hand spiral, has long enough taper to enter both holes before cutting full, and should pass entirely through, and not back again.

All further operations may be divided up according to expediency, but all should be performed while on the register ring. On a turret lathe it is possible to drill for center in head (if called for). The diameter of the head may be rough turned with offset turret tools, and the ring grooves may be rough turned to within $\frac{1}{64}$ in. in width and 0.005 in. in depth, and the head rough-squared with cross-slide tools.

After that, it has been found preferable to do all finishing operations in an engine lathe.

When finishing ring grooves, care should be exercised to see that all end play in the spindle is taken up either by bringing up the tailstock center to the center in the piston head, or in its absence, against a plate bearing on the head. The tool carriage should be locked in position to prevent any possible floating. "Go-in" and "not-go-in" gages are necessary for the grooves with limits of from standard for the "go in" to 0.0005 in. over standard for the "not go in." For instance for a $\frac{3}{16}$-in. ring, the gages should be 0.1875 in. for the "go in" and 0.1880 in. for the "not go in." It is essential that the tool bits should be gripped close in the tool holders, and that the holders do not project more than is necessary from the toolpost. All tools should be properly ground and carefully oil-stoned.

In discussing tool grinding, one is tempted to utter a wail over the passing of the old fashioned forged tools. In looking over the old-time tool board, we could see all the then approved shapes from the diamond point to the parting tool and goose neck, all of which were more or less religiously adhered to. The machinist prided himself on his ability to demonstrate wherein he excelled over the other fellows' grinding. Now the tool board is usually a small tobacco box containing a few stubby characterless bits, over which it is difficult to work up any enthusiasm.

Although all manufacturers use high-speed steels for roughing cuts, a great many advise using carbon-steel tools for finishing aluminum. It is quite possible to get a very satisfactory finish from a good, selected high-speed-steel tool when properly ground and carefully oil-stoned; it will usually hold a keen edge that will not break down under a light, well-lubricated cut.

A Proper Tool for Use on Aluminum

Generally speaking, it may be said that a tool properly ground and set so that it will cut an easy flowing, loosely curling chip from machine steel will be about right for aluminum; that is, its top rake should be a 25- to 30-deg. angle to the right, and about 15 deg. back. The forward or cutting corner should be well rounded, say to about $\frac{1}{16}$-in. radius. The face of the tool to the right of this corner need not be ground so as to recede very much from the work, as it is well to have the face just to smooth the ridges after the round corner removes the bulk of the stock. (See Fig. 3.) For finish turning only the middle portion of the face of the tool is used at *A*. This provides sufficient flat against the work to cover the feed comfortably despite the angularity of the face, and gives an easy shearing cut.

The same practice applies to parting tools for cutting ring grooves as for any other work. The tool should have sufficient clearance downward on both sides to make sure the prevention of rubbing. The top should have the least possible clearance back to prevent chips from wedging and they must be perfectly square with the work. It is very essential that the face of the tool be well oil-stoned, as the tendency for the material to stick and pile up on this tool is greater than on others.

As to cutting speeds, from 400 to 500 ft. per min. is a fair roughing speed (some manufacturers run 700 ft. or better), and from 125 to 175 ft. for finishing. (We usually run about 140 ft.)

A fair roughing feed is from 0.03 in. to 0.04 in. per rev. and a finishing feed should not exceed 0.02 in. per rev.; 0.01 in. will give better results.

The majority of shops do all their rough turning dry, but usually use some lubricant for finishing. Very satisfactory results may be obtained from a mixture consisting of about 70 parts kerosene and 30 parts lard oil. This should be used freely on all finish cuts. Wherever it can be arranged it is well to pump it directly on the cutting tool with enough force to wash the chips off.

Shops that are equipped with grinding machines can finish their pistons more satisfactorily than in the lathe. A Crystolen wheel of about a No. 40 grain and a J or K grade, when used with a lubricant even as lean as 10 parts lard oil and 90 parts water, will give a very beautiful and true finish to lynite pistons.

MODERN PRODUCTION METHODS

By
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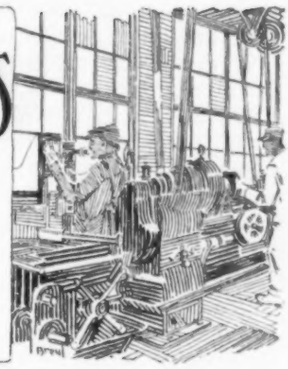


HERE is a conversation I once overheard which is typical of what occurs daily in too many machine shops:

Machinist (at toolroom window)—'Give me a 1/16-in. reamer and socket."

Storekeeper—"Here's the socket. Get the reamer from John Jones. I think he had it last."

Fifteen minutes later:

Machinist—"He hasn't got it and I can't find it."

Foreman (who overheard him)—"Well, keep lookin'. Ain't Jim told you he ain't got it?"

The conversation grew acrimonious, leading to impolite reminders by the workman that he was on piece work and wouldn't give his time to the search and to vituperative comments by the allied storekeeper and foreman. Too frequently the time lost in changing jobs and obtaining new tools is not sufficiently considered. The management may be conscious of the loss, but even in the most efficient plant the sum total of cost is seldom known. A study in this machine shop showed that the improper racking and follow-up of tools and the consequent loss of time amounted to 13 per cent of the productive labor payroll. If, under such conditions, the man's time were the only loss, it would be bad enough. But it isn't. First, an expensive machine is thrown into the non-productive list, piling up its many items of overhead expense. The production of the shop as a whole is decreased, throwing a heavier burden of general expense on every article manufactured. The rate of turnover is diminished, increasing the working capital needed. Then there is the moral effect on the men. The average working man takes his cue from his leaders. If the foreman is efficient and dispatches his work to the best advantage, the men will generally do their share; but if the foreman is careless and does not attend to detail the men will become imbued with the same spirit and do their work in a listless "I'll-do-what-I-must" manner. Delays do not bother them and they lose the ambition to turn out their work quickly and efficiently. When this condition exists the quality of their work is also very apt to suffer. After considering the many phases of this question it will be realized that the initial labor loss is small in comparison with the ultimate.

If a machine shop has the crudest vestiges of a cost system, its executives must realize the losses that such a waste of productive time causes. And yet the fear of system, which to many means "red tape," makes them prefer the loss to the cure. There is some cause for this feeling; but in the toolroom, as elsewhere, it is quite easy to have well-ordered handling and records without red tape. I would be the last one to advocate routine for the sake of the routine.

V. Tool Issue

The amount of time wasted at the grinding stand in the average shop is proverbial, but it doesn't seem to be shrinking to any appreciable extent. It is typical of the wastage all along the line where efficient methods of handling tools have not been introduced. Here the author describes a few flagrant cases, gives general remedies and points out the improvement resulting from the changes made.

(*Part IV appeared in our May 20 issue.*)

There are certain rules which should be followed by a well-run shop and which allow of practically no exceptions. There are other points which must be settled by the individual shop. The absolute ones are:

1. The proper tools should be available when the workman is ready to start an operation.
2. The exact location of every tool should be known.
3. It should be possible to tell at once just which tools any man has.
4. No workman should be allowed to sharpen, repair or make tools.

The questions which must be settled in the light of the peculiar needs of each shop are:

1. Shall workmen own any tools?
2. Shall tools be deliv-

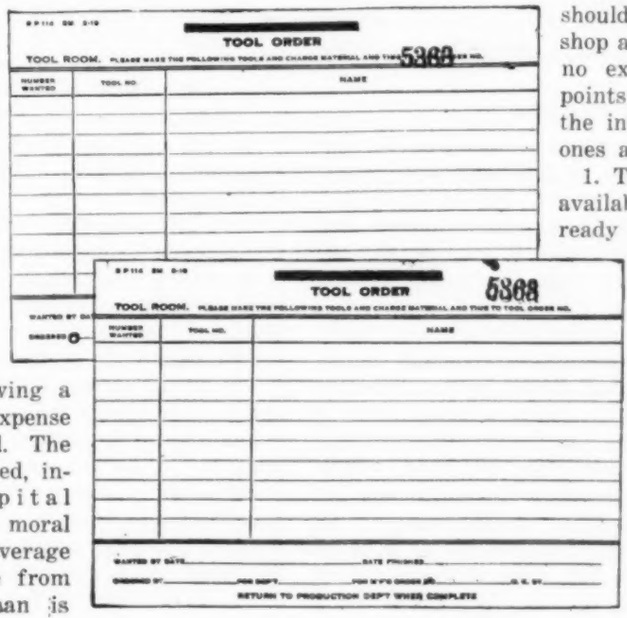


FIG. 16. TOOL ORDER FORM

ered to men or called for by them at the toolroom?

3. Shall men specify the tools needed?

4. Shall any tools remain permanently at the machine?

We saw in a preceding article how, when a part is to be made for the first time, the engineering department notifies the tool designers what is needed. This is done early so that the tools, jigs and fixtures may be ready before the part is released to the shop. This can be done whether a single part is to be made or a hundred thousand. Fig. 16 shows a form on which new tools may be ordered. A simple and obvious routine can be relied upon to follow the making of the tools through all the operations until they are delivered to the tool crib. The form shown in Fig. 17 may serve as a follow-up reminder whether the tool is made in the plant or ordered from the outside.

The Double-Check System

It is, of course, simple enough to know where tools are, if the customary single-check system is used. But it is also desirable to know what tools are in the possession of any man. This can be accomplished by the double-check system, under which not only is a brass check with the workman's number hung in place of the tool, but a check bearing the tool number is hung on a board under the workman's number. Thus, if a workman leaves the company, the exact tools in his possession are known. This method can be improved upon as will be indicated later.

The favorite gossiping place in any shop is the grinder. Here men may congregate and have a perfect alibi, for they "are waiting to get at the wheel." It's amusing, in shops which subdivide operations to the last hair, to see men who are little more than machine tenders, sharpening their own tools. The management does not consider them all-round mechanics, but apparently feels they are toolmakers.

Tools should invariably be kept in condition by men who do nothing else. This saves the time of productive men and assures that the tools will be ground to give the best cutting results. I can conceive of no shop employing fifty or more men where it would not pay to have at least one man to keep tools in condition.

When tools are turned in to the crib, they should be examined and repaired, if they need it, before being issued again.

Ownership of Tools

Personally, I believe that the shop may well furnish all tools used. This, however, will depend to a degree upon the nature of the work and the kind of men employed. If a shop is fortunate enough to have a few temperamental, all-round mechanics it may be wise to "compromise" and let the men use their own tools if they want to.

The big objection to a man owning his own gages is that he will not usually provide a sufficient range, nor are the gages he possesses always well adapted to the work he is doing. He may have a micrometer, a pair of calipers, a depth gage and so on. In up-to-date shops on repetitive work, snap gages are used, which, of course, the men cannot be expected to furnish for every job they may be put on.

If a man furnishes some of his own tools, it is, of course, out of the question for whoever inspects his kit when he leaves the plant to tell which tools belong to him and which to the company, unless, as seldom is done, the company's tools are stamped with the company name.

In the planned shop, it is, as a rule, best to have tools delivered to the men a short time before a new job is started. This is handled by the planning department which knows not only what tools are needed, but just *when* they will be needed. In job shops where it is not feasible to forecast the approximate time when a new job will start, it is best for the workman, or perhaps the foreman, to get the tools.

It is always possible to determine what tools will be needed for a job. This should be done by the engineering department. Of course if no engineering department exists, the judgment of the workman or his foreman will have to govern.

As a rule it is best to have the tool turned in to the crib when an operation is finished. There is no great objection, however, to having certain standard cutting tools for lathes, planers, etc., remain permanently at the machine.

However these questions are answered, I want to impress the importance of having a close control of tools exercised by the tool crib. If this is not done, great wastes can go on.

TOOL FOLLOW-UP CARD

PC. No.	REQ. No.	TOOL ORDER No.
DATE OF ORDER		
DESCRIPTION OF TOOL		
WHERE MADE		
AMOUNT ORDERED		
DATE PROMISED		
DATE COMPLETED		
AMOUNT COMPLETED		
STANDARD PARTS A B PLANT		

FIG. 17. FOLLOW-UP CARD ON NEW TOOLS

Take, for instance, the case where it was possible to cut, at pre-war prices, the investment in tool steel $13,000. It was evident, on casual observation, that the investment in tool steel was too high.

We found that there was no real system in use for handling tools, nor were there any standard prints from which they could be made. Each foreman, as he needed, or thought he needed, tools, or even at times the operator on the machine, would go to the stockroom and get sufficient steel to make such tools as he wanted.

He would then take this stock to the blacksmith who would forge them up for him in the way he described. If he had a preference for a tool with a large clearance or rake angle, the tool was made up that way. Frequently we found another foreman requesting a tool for identically the same work, but with a different angle.

Not at all infrequently a foreman from one of the outlying buildings would send in a written order for a quantity of a certain tool which he would describe roughly. If he did not receive them he might send in another order, not mentioning the first at all. In due time he would receive just twice as many tools as he ordered and that would probably be about three times as many as he needed.

We first investigated where the tools were kept. There did not seem to be a very great congestion in

the tool cribs, although there were seemingly a few more tools there than necessary, but on going out into the shop to the machines we found even more trouble.

A night and day turn was employed, and as the tools were ground by hand by the operator himself, no man was ever satisfied with any other man's grinding; consequently, the night man on a job always tried to hold his tools away from the day man and vice versa. There was always a duplicate set at a machine and frequently sets for several jobs which the operators had collected and never turned in.

At ten machines we found an average of thirty tools weighing on an average, 5 lb. apiece. These were all of high-grade tool steel, costing at that time about $6 a pound. One can easily see that here was a lot of money tied up in tools that only a few operators could use.

30 tools @ 5 lb. each = 150 lb. per machine.
150 lb. @ $6 per pound = $900 per machine.
$900 × 10 machines = $9,000.

Then at forty-two other machines we found the following conditions:

5 tools @ 4 lb. each = 20 lb. per machine.
20 lb. tools @ $5 = $100 per machine.
$100 × 42 machines = $4,200

A lower-price steel was used on these machines. These figures do not include tools in use at the machine at that time.

Here is a total of $13,200 tied up in tool steel which was being used only a small portion of the time, as only a maximum of eight tools was ever used at one time on one job, and many jobs used considerably less. While one job was running on the machine, the tools for all the other jobs were idle in the workman's tool box. Had they been handled from a central crib they might have been in use on some other machine.

Several of the men's tool boxes were so heavy that it was impossible to move them when we tried to take them into the crib, and the tools had to be taken out and piled on a hand truck. These tools were all taken into the central tool crib, and all similar tools were placed in the same bin so that the complete stock of any tool could be immediately ascertained. After sufficient data had been obtained as to the usage of the different types, a minimum limit and desirable amount to order was placed on the bin tag and the stock was kept within these limits by requisition on the tool stock.

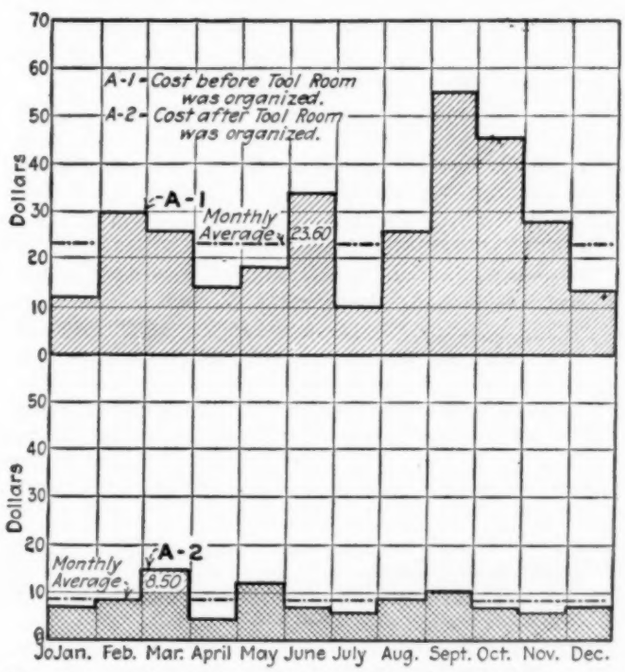

A-1 = Cost before Tool Room was organized.
A-2 = Cost after Tool Room was organized.
A-1
Monthly Average 23.60
A-2
Monthly Average 8.50
Dollars
Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.

FIG. 18. CHART SHOWING SAVING IN TAPS AND DRILLS

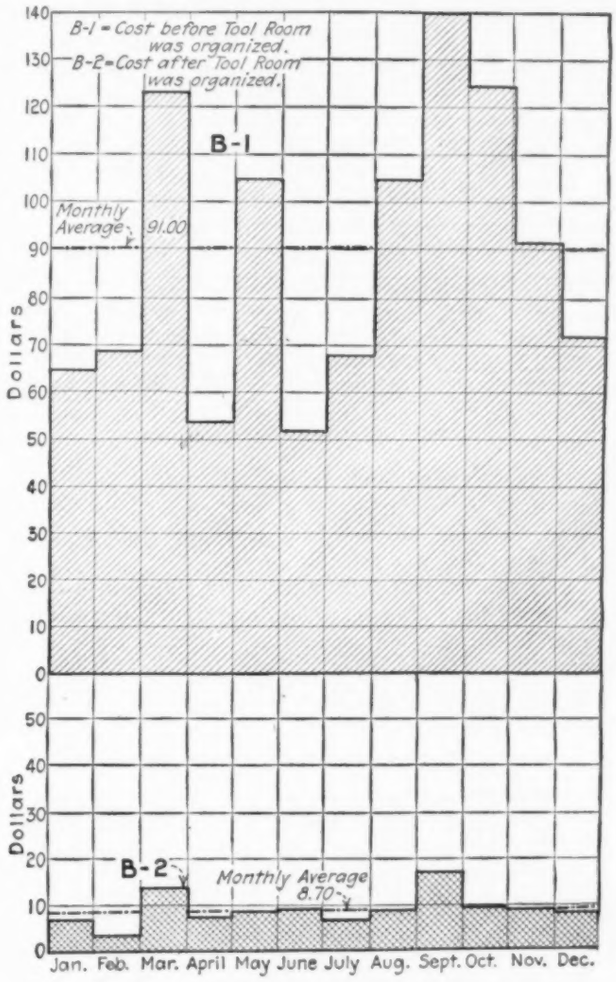

B-1 = Cost before Tool Room was organized.
B-2 = Cost after Tool Room was organized.
B-1
Monthly Average 91.00
B-2
Monthly Average 8.70
Dollars
Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.

FIG. 19. CHART SHOWING SAVING IN FILES AND HANDLES

The System Devised

A brass-check system was in use at this time for keeping track of the tools that were out; but as there were two turns it necessitated turning tools out and in both night and morning. If this was done, there was constant trouble between the two turns; consequently a system of written slips was installed.

This operated as follows: A tool list was written in triplicate for all tools ordered out, one list remaining in the crib, while the other list would be given out—one to the day man and one to the night man. Then if the tools were given out to the day man, the night man, when he came in, checked over the tools with the list given him. If any were missing, he reported the fact to his foreman for adjustment. If he did not report it, and turned in the tools later with one missing, a charge was made against him.

At the same time it was found desirable to start a central tool-grinding department where all similar tools might be ground the same. The tools in the crib

SHOP SUPPLIES.

Charge Acct. 20-Ma. Date 7-7-19

Stock Delivered Only on this Order.

Store Keeper:
Please deliver the following Supplies:—

Amount	Size	MATERIAL	Rate	Amount
1	T-2977	Form Tool		18 68

To be used for the following purpose:—

New Work	Repairs	Operating	NAME OF DEPARTMENT	Symbol
		X	Ma	5919

NOTE.—Make a cross in Block showing for purpose material is to be used.

F. Rodenberg, Foreman.

FIG. 20. TOOL REQUISITION

were kept ground, and when a man had a dull tool, he turned it in and received a new one. This not only saved time but assured that each tool was so ground as to give the best possible service.

This central tool department also maintained a stock of forged tools on a minimum and desirable amount-to-order basis, so when requisitions for tools came in they were filled from stock. This tended, naturally, to standardize the tools used and tool numbers were placed on all which were necessary.

Reforging Worn-Out Tools

Worn-out tools were returned to this department and it was decided there whether or not they could be reforged into another shape. This alone effected a saving of about $152 a month in scrap tool steel.

The chart, Fig. 18, shows the saving made in taps and drills in one plant by making only elementary betterments. The management was so afraid of red tape that it would not countenance a really modern method of handling tools. But even with the rudimentary changes made, the saving in the one item of taps and drills amounted to $180, and in files and handles $987, in one year. The latter item is shown graphically in Fig. 19.

Formerly nearly all of the shop tools were allowed to remain in the care of the operatives at their benches or machines. Many workmen accentuated this semi-ownership by keeping the tools under personal lock and key. As no record existed showing what tools belonged to the company, it was a very common occurrence to find that tools had vanished—where to, no one knew.

In an effort to determine where these tools were or how they had been disposed of, an examination of every operative's tool stand or bench drawer was made.

Tool Release Order

Please Release Check No. 379 on the following:—

No.	SIZE	ARTICLE	BROKEN	DAMAGED	COST
1	T-2977	Form Tool Part-5919	X		18 68

NOTE.—Mark × in column denoting condition.

Date 7-7-19 Foreman J. Kuckel

Dept. No. Ma

FIG. 21. TOOL RELEASE ORDER

The result was that drills and taps, in quantities ranging from 50 to 150 per size, were found at the benches. The majority were usable, only a small expenditure being required to put them in shape. The men in the shop, when questioned, admitted that if a drill or tap became damaged, they went at once to the shop office for another. The assistant foreman would give the tools out; even suggesting—"better take two or three and you won't have to bother me again so soon."

Summed up, the unnecessary investment and subsequent loss in stolen, mislaid, idle or needlessly discarded tools was due to the common carelessness of the foreman and his assistant.

The first step was to centralize tool storage in a crib.

As tools are taken from this and given to the workman they are listed on a standard card, and filed by the man's number (in a 3 x 5-in. card file) in the toolroom.

Drills and taps were given out only upon the return of the shank end of the tool originally supplied. Files and handles could be secured only by returning the old ones. Bolts and machine screws were not given out by the box as before; but according to the quantities specified on the bill-of-material. Additional tools were issued only upon presentation of a tool check.

All locks were removed from bench drawers and a standard lock used throughout the shop. Each workman was given his key, a master key fitting all locks being placed on the key board in the toolroom.

Another Simple System

The following simple tool system—one we recently installed in a well-planned shop—indicates the routine

DATE MOVED
PIECES WANTED
COMPLETED
REJECTED
CREDIT
MOVE TO DEPT. Ma
TO MACH. 382

PRODUCTIVE SERVICE CARD FORM 128

MAN NO. 349

OPERATION: Drill, ream, & form & cut off.

ORDER NO. 1715 LOT 1

PART NO. 5919

TOOL NO. M-A-77 OPER. NO. 1 MACH. NO. 493 DEPT. Ma

DATE TOTAL P. PRICE .0152

ELAPSED HOURS CHANGE MACH.

HOURLY RATE 7-31-19 M. TOTAL CREDIT

FIG. 22. JOB TICKET GIVING TOOL SET-UP

MACH. NAME LIST NO.

MACH. NO. DRAWING NO.

PIECES	NAME	SIZE	SYMBOL	LOCATION
	(over)			

WHEN THE TOOL LIST IS NOT CORRECT THE FOREMAN MUST REPORT THE ERROR AT ONCE TO THE PRODUCTION OFFICE. DATE SIGNED

TOOLS CALLED FOR ON THIS LIST MUST BE ISSUED TOGETHER

Form G-109 **TOOL LIST**

FIG. 23. TOOL LIST

FIG. 24. ISSUING TOOLS IN BOXES

that can easily be adapted to nearly any needs. It assumes economical handling of tools.

Briefly, these are the points we took up:

1. We gave all tools a number.

2. We classified all tools as jigs, fixtures, gages, tools, dies, etc.

3. We listed tools needed on operations for every part manufactured, showing the tool number, name and size.

4. We rearranged the tool cage and divided it up into sections; each section divided into bins and drawers for all tools and gages.

5. We installed an "in-and-out" tool cage record and used this for each tool. It is a card which shows the tool number, name, location in the tool cage, what part it was used for, what operation, the maximum and minimum stock required and the operator who has the tools out, with his name and number. Whenever a tool is used or broken, it is entered on this card, thus showing at all times the balance on hand.

6. We designed a tool requisition for the issuing of all tools, showing the operator's name, number, department in which he works, the tool name, number, size and number of each kind needed.

7. Tools to be repaired are entered on a repair order in triplicate by the man in charge of the cage. The original remains in the cage, the duplicate goes with the work to the toolroom, and the third copy is sent to the layout man in the planning department for his planning. Each copy shows the tool name, number, size, nature of repair and when wanted.

On all productive operations the tool requisitions are handled entirely by the control board operator, in the central planning department. On all other work the tool requisitions are handled by the foreman.

The tool requisition is made out in duplicate, signed by the foreman and then sent to the tool cage. The tool cage man first sees if the tools are in by looking on the "in" file of the tool cage record. If they are in the tool cage, he enters all tools called for on the requisition or the "in" cards and places the cards in the "out" file. The requisition is then filled, and the original is filed against the operator's number and the duplicate sent with the tools to the operator so that he can check the tools.

Filing the tool requisition, Fig. 20, against the operator insures that he will return all tools before being paid off if he is discharged or quits, as the tool cage man must sign his "tool release order" (shown in Fig. 21) before he is paid.

When the tools are returned by the operator, they are checked against the tool requisition to see that all the tools called for on the requisition are returned. They are then sent to the tool inspector to determine their condition.

After the tool inspector approves their condition, he signs the tool requisition and turns it over to the clerk in the tool cage who enters the tools returned on the "out" card of the tool cage record. This card is then placed in the "in" file.

In any shop where the tools to be used for an operation are specified by the engineering department, it is well to have a copy of the parts list or of the shop order, Fig. 22, sent to the toolroom. This may show simply the tool number, as does the one illustrated. Or from the list of tools needed for any operation, which is on file in the toolroom, the proper tools, gages, fixtures, and instructions are collected in a tray and sent to the machine, ready for the set-up man. Such a form listing the tools needed with a full description of them and showing their location is shown in Fig. 23.

To prevent the shut-down of machines due to breakage, all tools that are subject to easy breakage or that are unusually delicate are furnished in duplicate.

The requisitions for tools, etc., received from the planning department are filed in the tool crib against the man, machine or unit to which they were sent. When the tools come back they are checked and breakage immediately replaced and reported.

Often where an operation repeats quite frequently it is well to have permanent sets of tools, gages and so on kept in boxes, as shown in Fig. 24. Sometimes duplicate boxes are advisable. This does away with the trouble and time taken in gathering sets together. The set-up or other instructions may be pasted to the inside of the set-up box cover, or as in this instance a list of tools like that shown in Fig. 25 may be shellacked to the bottom of the box.

A performance record of various tools is not hard to keep and frequently will point the way to considerable economies. It may for instance indicate a saving

FORM 143

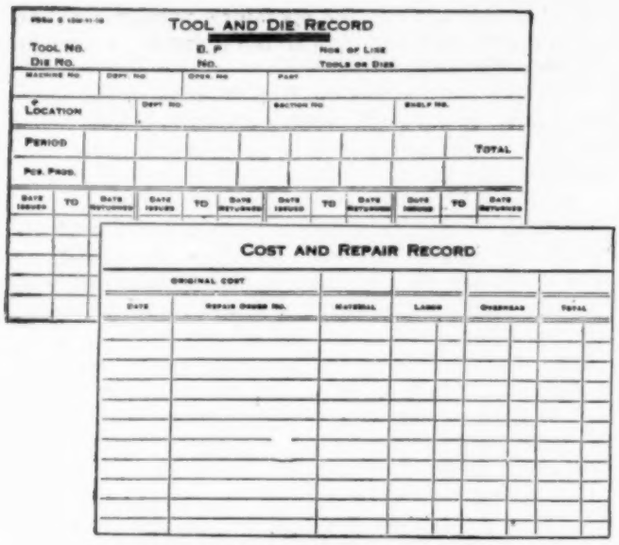
BOX NO MA-77

MODEL L-Hdy Duty OP. Drill, ream, form & cut off

TOOLS REQ'D

QUAN.		SHORTEST LENGTH
1	T-2977 - Form Tool	
2	T-581 - Turning Tool	2½"
1	T-2496 - Reamer Shank	-
2	17/32 M Shank H.S. Oil Drill	6"
2	1.182. H.S. Sheet Reamer	
1	1.180 to 1.184 Not Go Plug Gauge	

FIG. 25. TOOLS REQUIRED LIST


TOOL AND DIE RECORD

Tool No.
Die No.
B. P. No.
Nos. of Like Tools or Dies
Machine No. | Dept. No. | Oper. No. | Part
Location | Dept. No. | Section No. | Shelf No.
Period | Total
Pcs. Prod.
Date Issued | To | Date Returned | Date Issued | To | Date Returned | Date Issued | To | Date Returned | Date Issued | To | Date Returned

COST AND REPAIR RECORD

Original Cost
Date | Repair Order No. | Material | Labor | Overhead | Total

FIG. 26. PERFORMANCE RECORD FORM

through purchasing tool steel of just the right quality.

Fig. 26 shows both sides of such a card record. It combines a record of the location of the tool or die with a record of the production obtained from it, the cost of making the tool and of repairs that become necessary.

While such a record is of particular value for a tool which is in use for long periods at a time it may well be used for any tool which is expected to stand up under quantity production.

Welding Malleable Iron

By Fred B. Corey

From the standpoint of the autogenous welder, a malleable-iron casting presents more peculiarities and is a more prolific source of trouble than any other metal with which he has to deal. The reasons for this condition do not seem to be generally understood, although those who have made a study of it know that the trouble is due to the unstable condition of the carbon in the metal.

In order to gain an understanding of this matter, we will briefly review the process of producing malleable-iron castings. As originally cast in the foundry, the iron is white in color and almost as brittle as glass. These hard, white castings are packed in annealing pots and subjected to a temperature of 1,600 deg. F.

After holding the pots at this temperature for a considerable time, in some instances 80 hours, they are very slowly cooled. During this heating and cooling, the structure of the iron undergoes a radical change. The carbon, which in the original castings was in chemical combination, becomes dissociated from the iron, segregating in the form of graphite and imparting a black color to the resulting material.

Metallurgists do not seem to be in agreement as to whether this change takes place at the time of subjection to the high temperature or during the subsequent cooling. It seems probable that it occurs largely during the cooling process, as a too rapid cooling causes excessive hardness in the finished product. For the best results, the rate of cooling should be not more than 20 deg. F. per hour.

In order to make this change clear, two photomicrographs are shown herewith. Fig. 1 is from a sample of the white, hard iron before annealing, showing the fine crystalline structure of this material. These minute hard crystals lie in more or less irregular rows throughout the mass. Fig. 2 is from a piece of the same casting after annealing, showing the black masses of graphite separated from the iron, while the purified iron is left in a soft, ductile state.

If the iron shown in Fig. 2 was again heated and very slowly cooled, the structure would not be greatly changed, or if it was heated to a comparatively low temperature and cooled quite rapidly, the iron would still be soft. If, however, it was highly heated and cooled rapidly, the structure would again change and become similar to that shown in Fig. 1.

We are now in position to understand what happens when we try to produce an autogenous weld in a malleable casting. If the casting is merely brazed, using a filler rod of tobin bronze or similar material, the cast-

FIG. 1. STRUCTURE OF MALLEABLE IRON AS CAST

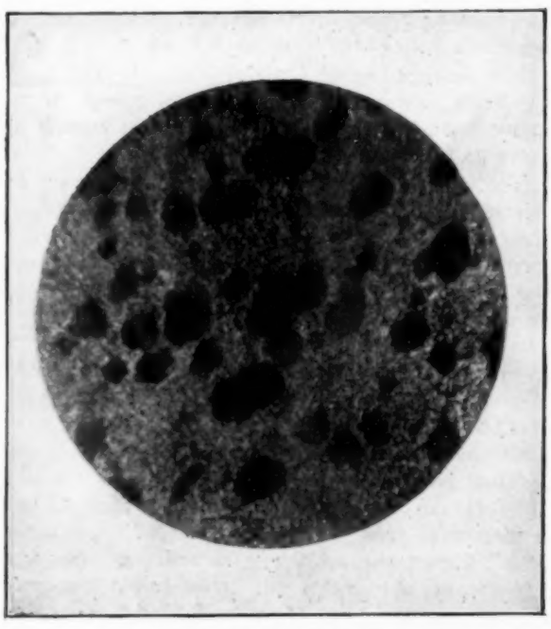


FIG. 2. SHOWING CHANGE DUE TO ANNEALING

ing need not be heated to a sufficiently high temperature to recombine the carbon and a fairly good job may result. If an iron filler rod is used to make a weld, a much higher temperature is required. The weld itself may then be soft, but this weld will be surrounded by a zone of hard iron where the heat has been high enough to cause the carbon to recombine with the iron. The resulting structure, throughout this surrounding zone, will be somewhat similar to Fig. 1. It is this tendency of the carbon to recombine with the iron when heated that causes the lack of success of the autogenous welding processes when applied to malleable-iron castings.

The writer has salvaged many defective malleable-iron castings from the foundry by having them welded. In all cases these castings have been welded before they were annealed, using filler rods of white iron of the same composition as the castings. The welded castings were then subjected to the regular annealing process which, of course, produced a perfectly homogeneous structure as a final result. When a real weld is desired, this method seems to be the only one that will give entire satisfaction with this peculiar metal.

The Trade Trained Boy

By Clarence MacNiven
Instructor, Connecticut State Trade School at New Britain

Until recent years, the belief has generally prevailed among parents that any boy, even though not up to the mark in his studies at the grammar school, could enter, and graduate from, a trade school; for, they considered the trade school taught only manual dexterity and called into play but little brain activity.

This condition no longer exists. It has been made plain to parents that a boy, to be acceptable as a student in the State trade school, must show a creditable degree of proficiency in his school work, and a degree of mentality quite on a par with the average youth of his age.

We have in this city a school, known as the Prevocational Grammar School, which has the following departments: Machine, drafting, printing, woodworkng and job and repair. These departments are in operation every school day, and each grammar-school pupil who elects to take the "Arts and Crafts" course is required to devote nine hours per week to these studies in their consecutive order. This training not only broadens the pupil's mental vision and gives him a more comprehensive view of his future relations in the business world, but it enables the vocational adviser to judge to better advantage the pupil's natural inclination or aptitude for one or the other of these trades.

The boy's future course of training is governed to some extent by this means, thereby eliminating to a considerable degree the misfits that formerly came to us determined to learn this, that, or the other trade for no other reason than that the trade selected "paid more money" or was the trade followed by their fathers.

The prospective student is entered at the training school according to the card made out at the prevocational school and is closely watched for the first few days, until we are assured by his manner of taking hold that he is upon the right track. Sometimes, after a week or so, the boy under observation develops sluggishness and lack of interest in his work, and at such time we try, by earnest talks with him, to bring out his true leaning. We try him in other departments, keeping up the same watchful oversight of his actions for a period of several weeks, or until we have located him in the trade for which he is naturally adapted or satisfied ourselves that he will not be successful in any trade within our field.

Once his course of training is determined upon we start him upon those problems involving the least mental effort, seeking rather to concentrate his efforts upon purely manual movements, until he has become accustomed to his new surroundings and feels himself "at home" among them.

This precludes the possibility of starting all boys in the same way. A cut and dried routine must never be followed. The boy's size and age must be taken into consideration, and his characteristics carefully studied before deciding upon what is best for him.

Many boys come to us without the pre-vocational training; some who have finished the grammar school course intending to supplement it by high school or technical training, but who through misfortune or from other causes have decided to take up a trade. In such cases we have no other guide than our personal observations as to the best way to handle them. Because of this it is necessary to include in all courses the most elementary problems and practices of the chosen trade in order to make sure that no essential part of the foundation of the boy's education has been neglected to develop embarrassing results at a later period.

We teach drafting, pattern making, machine work, electrical construction and printing. The period of instruction covers 4,800 hours; the working time being eight hours per day, five days per week, and four hours on Saturday. At least one-quarter but not more than one-third of the 4,800 hours must be devoted to academic studies.

Under our State laws, a boy may leave school at the age of fourteen, provided he gets a working certificate from the State Board of Education, but most of the larger employing concerns do not care to bother with boys at this age because of the trouble involved in keeping the certificates on file and complying with the requirements of the law. Therefore, the average boy who is not taking a high-school course has two years that can most profitably be employed in learnng a trade.

The object of the trade schools is to teach the boy the fundamental principles of the trades within their scope; carrying out the manual instruction contemporaneously with the mental training so necessary if manual skill is to be developed to its highest degree.

We do not instruct from a platform. Our work is conducted in much the same manner that it would be carried on by a competent and conscientious foreman of a factory department personally instructing an apprentice. If we are teaching a boy to operate a lathe, we take him to the machine, show him its various movements and give him certain pieces of work to do with which he can demonstrate its capabilities and which, when he has finished represents a component part of a tool or machine possessing real value. This is a factor of inestimable importance in awakening and holding a boy's interest in his work.

We endeavor to grade our course so that a boy may get the greatest possible variety of work consistent with a thorough understanding of the principles involved, for a boy does not have the stamina to stick to routine work that an older person possesses and is therefore likely to lose interest if kept too long on one job.

Heat-Treating of Brazed Fittings for Aircraft

By ARCHIBALD BLACK

Heat treating and brazing have not generally been looked upon as processes that could be easily applied to the same piece. The automobile has left its mark upon shop practice and here we come upon an evidence that the airplane is likely to have as great an effect.

A TENDENCY exists in most shops to assume that brazed joints cannot be successfully heat-treated. As a consequence, many fittings used in aircraft work and assembled by brazing smaller parts together are finished and installed without being heat-treated after the brazing operation. This practice causes parts to be used that not only do not develop the available strength of the material, but which are even, in some cases, under internal stress due to the heating in the brazing operation. It has been shown by some recent experiments, made at the Naval Aircraft Factory, that this assumption is entirely erroneous. It is therefore advantageous to consider this matter with a view toward specifying the use of steels and brazing spelters which will permit the subsequent or perhaps the simultaneous heat-treatment of the parts.

Materials

Considering the spelters required for such work, it is necessary to know not only their melting but also their approximate softening points, to avoid the destruction of the brazed joint during heat-treatment. Fig. 1 gives the approximate melting points and tensile strengths of several different compositions which provide a wide range for selection. These values are, however, subject to slight modification, due to the presence of some 1 to 1.25 per cent of impurities in commercial spelters, yet for the purpose of this work they may be considered correct, and it is recommended that the curve of tensile strength be assumed correct for the strength of the spelter in a brazed joint.

More detailed information of the properties of spelters is given by Hofman. Information about softening points is not so definite. Something can be learned from the equilibrium diagram for brasses given by Hofman, and also from a test made by the Naval Aircraft Factory which showed that a brazing wire of 80-20 brass mixture appreciably softened at about 50 deg. F. below its melting point.

Considering the steels likely to be required for the construction of aircraft parts, by consulting specifications issued by the Air Service and by the Bureau of Construction and Repair of the Navy Department, it is

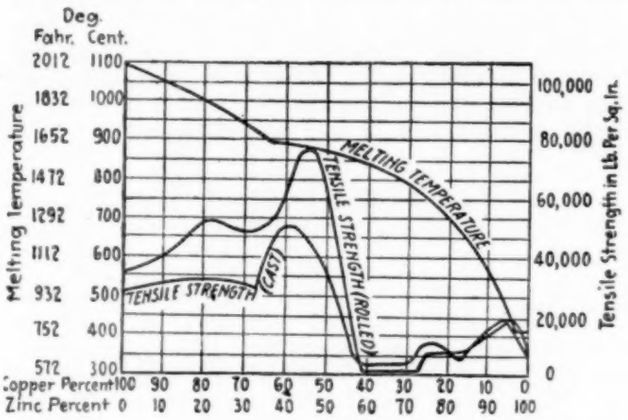


FIG. 1. APPROXIMATE MELTING POINTS AND TENSILE STRENGTHS OF SPELTERS

found that a typical list such as that given in the accompanying table can be compiled. This table is reproduced from aëronautical specification No. 89a of the Bureau of Construction and Repair, Navy Department, for the heat-treatment of brazed joints and is based upon work done by the division of metallurgy of the Bureau of Standards.

As is well known, when steels are heated or cooled, irregularities in the rise or fall of temperature take

TYPICAL LIST OF STEELS USED IN AIRCRAFT WORK, WITH THEIR APPROXIMATE PROPERTIES

Steel	Heat Treatment: End of Upper Critical Range on Heating, Deg. Fahr.	Heat Treatment: Hardness After Oil Quench: Brinell	Heat Treatment: Hardness After Oil Quench: Shore Scleroscope	Heat Treatment: Drawing Temperature, Deg. Fahr.	After Heat Treatment: Hardness: Brinell	After Heat Treatment: Hardness: Shore Scleroscope	After Heat Treatment: Tensile Test: Ultimate Strength Lb. per Sq.In.	After Heat Treatment: Tensile Test: Yield Point Lb. per Sq.In.	After Heat Treatment: Tensile Test: Elongation in 2 In., per Cent
Mild carbon (0.15 to 0.35 per cent carbon)	.....	150 to 225	30 to 40	800 to 1,300	180 to 130	30 to 20	90,000 to 60,000	60,000 to 40,000	18 to 26
Medium carbon (0.35 to 0.55 per cent carbon)	.....	225 to 325	40 to 55	700 to 1,200	250 to 180	40 to 30	110,000 to 90,000	80,000 to 60,000	16 to 20
High carbon (0.55 to 0.75 per cent carbon)	.....	325 to 380	55 to 70	250 to 1,000	325 to 250	65 to 40	160,000 to 125,000	125,000 to 90,000	2 to 10
High carbon (0.75 to 1.05 per cent carbon)	.....	380 to 420	70 to 90	250 to 1,000	400 to 325	90 to 65	250,000 to 160,000	200,000 to 125,000	2 to 10
Nickel (0.20 per cent carbon, 0.50 to 0.80 per cent manganese, 3.25 to 3.75 per cent nickel)	1,390 to 1,330	350 to 550	50 to 80	900 to 1,100	275 to 200	44 to 34	140,000 to 108,000	110,000 to 78,000	20 to 25
Nickel (0.40 per cent carbon, 0.50 to 0.80 per cent manganese, 3.25 to 3.75 per cent nickel)				600 to 900	400 to 295	60 to 44	215,000 to 155,000	190,000 to 130,000	12 to 16
Low nickel chromium (0.35 to 0.45 per cent carbon, 0.50 to 0.80 per cent manganese, 1.00 to 1.50 per cent nickel, 0.45 to 0.75 per cent chromium)	1,385	400 to 600	60 to 100	700 to 1,100	360 to 245	60 to 42	204,000 to 112,000	168,000 to 94,000	10 to 17
Chromium-vanadium (0.35 to 0.45 per cent carbon, 0.50 to 0.80 per cent manganese, 0.80 to 1.10 per cent chromium, over 0.15 per cent vanadium)	1,425	400 to 600	60 to 100	800 to 1,400	440 to 210	60 to 25	220,000 to 105,000	190,000 to 65,000	10 to 20

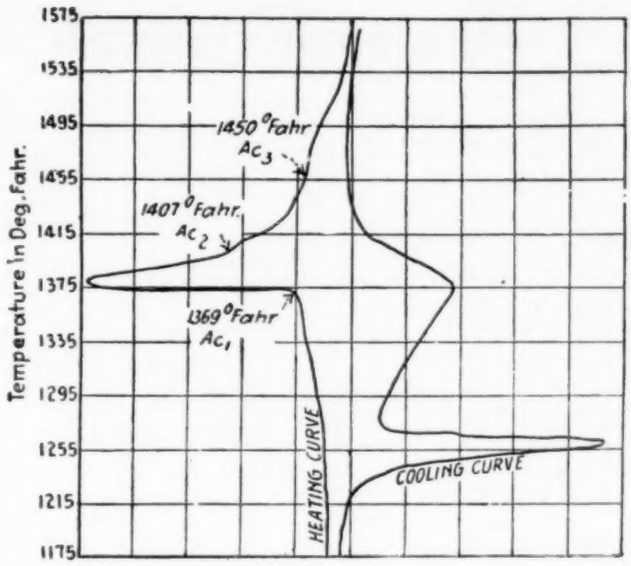


FIG. 2. HEATING AND COOLING CURVE FOR STEEL

place at certain periods, indicating internal changes in the material. These so-called critical points are actually short ranges but are known in steel technology as the Ac_1, Ac_2 and Ac_3 points where they occur during heating and the Ar_3, Ar_2 and Ar_1 points where they occur during cooling. Fig. 2 is a typical heating and cooling curve, showing the transformations for a steel of 0.3 per cent carbon and 0.7 per cent manganese, and Fig. 3 is the "equilibrium diagram" for straight carbon steels and is correct for 0.05 to 0.80 per cent carbon, at temperatures of 700 to 950 deg. C., the critical points being clearly shown. Such diagrams are usually only approximate, however, as they are affected by the impurities always found in commercial steels. An extended discussion of the heat-treatment and metallography of steel will be found in Sauveur, Bullens and other standard works.

In the heat-treatment of a steel it is necessary to quench it from a temperature slightly above the upper end of its higher critical range, the actual temperature depending largely upon the size of the part being treated. As a general rule this temperature should be at least 50 deg. F. above, and if information is not at hand concerning quenching temperature. it is advisable to consult the steel manufacturer for advice on the entire heat-treatment, rather than to attempt any experiments. The Midvale Steel & Ordnance Corporation issued a booklet containing much information about its series of alloy and tool steels, which is of general value. If the parts are to be brazed and heat-treated, a

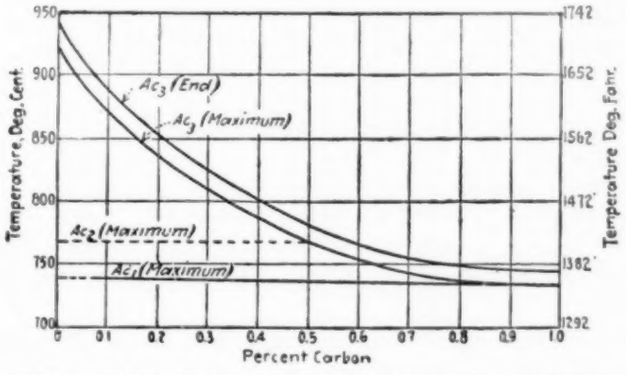


FIG. 3. EQUILIBRIUM DIAGRAM FOR CARBON STEEL

spelter should be selected such that the quenching temperature of the steel employed will be at least 125 deg. F. below that at which the brazing spelter melts, and, if possible, this difference should be greater to avoid danger of destroying the brazed joint during heat-treatment.

HEAT-TREATMENT

If the parts are to be brazed first and heat-treated in a separate and subsequent operation, the two operations can be handled in the usual manner, except that it may be found necessary to take special precautions to avoid warping during heat-treatment. It would seem advisable, however, to rivet, spot-weld or otherwise fasten the parts together before brazing, so as to prevent trouble from slippage of the joints during the subsequent heating. This practice of fastening parts together before brazing is in use in many shops at present and has been found to facilitate rather than to hold up production in most cases. Boulton gives a detailed discussion of brazing.

The operations of dip brazing and heat-treating can be combined by selecting steels and brazing spelters

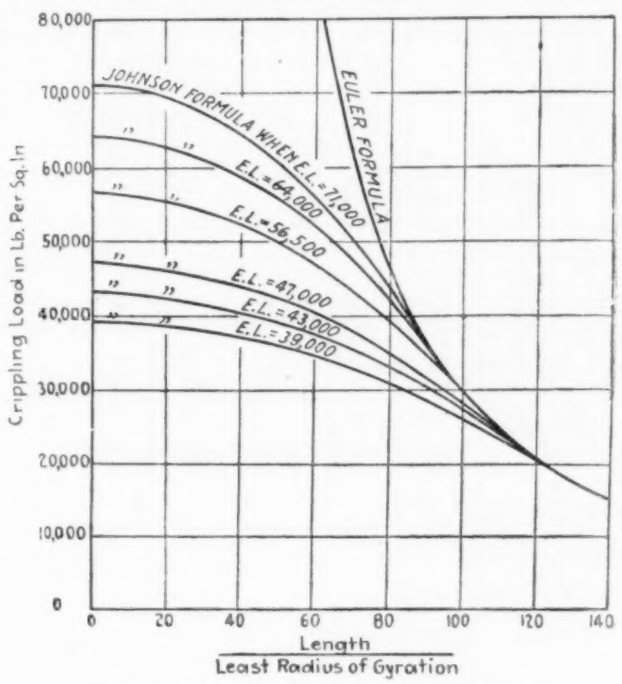


FIG. 4. GRAPHS OF COLUMN FORMULAS

which have the necessary quenching and melting temperatures respectively. In this method the brazing spelter should be maintained sufficiently above the specified quenching temperature of the steel to insure quenching at the proper point. If possible, a brazing spelter should be selected which has a melting point sufficiently above the specified quenching temperature of the steel to permit the practice of allowing the brazing to set slightly before quenching. If, however, the temperature of the brazing pot is allowed to approach 1,750 deg. F., the composition of the spelter will be subject to a gradual change, due to the rapid volatilization of the zinc, with a resultant rise in its melting point. The parts should be allowed to remain in the pot sufficiently long to raise the temperature of all of the material to that of the spelter, and should then be withdrawn and immediately quenched in accordance with the instruc-

tions of the heat-treatment being used. The re-heating and drawing operations can then be followed in the usual manner.

As the combinations of processes described are new to the workmen, it is very advisable to proceed with caution in attempting to introduce them into the shop. Once the workmen become familiar with the methods and the proper materials have been determined and obtained, they possess considerable advantage in permitting the designer to make use of the important gain in strength due to heat-treatment, with the consequent lightening of the larger parts.

It is well to mention, however, that no material advantage will be gained by heat-treating many of the tube struts or frames used in aircraft work, inasmuch as these are loaded as columns when in service. An examination of Euler's formula for crippling loads of long columns will show that the strength of such columns is determined by the form of the column and the modulus of elasticity of the material used, the strength of the material not entering into the equation. Many tests have shown that the modulus of elasticity of steel is practically unaffected by heat-treatment, in addition to varying but little with great differences in the chemical composition. Thus, for example, a strut of heat-treated alloy-steel tubing will cripple at practically the same load as a strut of the same dimensions but of annealed low-carbon steel, providing (*a*) that the slenderness ratio is sufficiently high to justify the use of Euler's formula, and (*b*) that the ends are designed to transmit the loads without local failure. Fig. 4 shows the graph of Euler's formula, together with the graphs of Johnson's formula for various elastic limits, corresponding to different steels, and illustrates very plainly that nothing is gained by the use of high-strength steel where the length divided by the least radius of gyration exceeds about one hundred.

Brain vs. Brawn

By John A. Honegger
President, Production Engineering Co., N. Y.

In glancing through a New York daily newspaper recently, the writer noticed the several help-wanted ads for designers and engineering draftsmen which are given here. One read as follows:

> Wanted: Technical graduate experienced in factory construction, plant lay-out and general machine design to act as assistant to Plant Engineer.
>
> Salary to start $28 per week, with advancement. Give full particulars in first letter. Box ABC-123.

and another:

> Wanted: An engineer experienced in general mechanical drawing and shop practice, as instructor in a technical school.
>
> Salary to start $2,000 per annum. State full particulars when applying for position.

and still another:

> Wanted: Draftsman, preferably married, who can design special equipment for increased production in a manufacturing plant.
>
> Must have some knowledge of automatic design. Will act as assistant to superintendent. Salary to begin $35 per week.

Immediately preceding these ads were others for chauffeurs at $40 per week, bricklayers at $1.25 per hour and carpenters $1.25 per hour and following them were those for plasterers at $1.25 per hour, presshands $40 per week and ship-yard men $50 to $60 per week.

Is it any wonder that numerous technical men are leaving the field of engineering for more lucrative positions in other fields of endeavor? The writer personally knows of several cases where technical men, who have been in the engineering field for the last ten or fifteen years, have left this field, taken jobs as riveters' helpers, chauffeurs, etc., and received considerably more financial benefit than in the engineering field. The writer employs, on an average, ten draftsmen and the lowest pay to the youngest detailer is considerably more than that offered to the assistant plant engineer.

For the amount of time and energy spent by the average draftsman in becoming a proficient worker the financial return is nowhere near sufficient. In order for a draftsman to become a successful designer he must have a working knowledge of pattern making, foundry practice, mechanical drawing, mechanics, algebra, geometry, trigonometry, machine design, tool design, production methods, and numerous other subjects. In addition to this, he must keep up to date in his work.

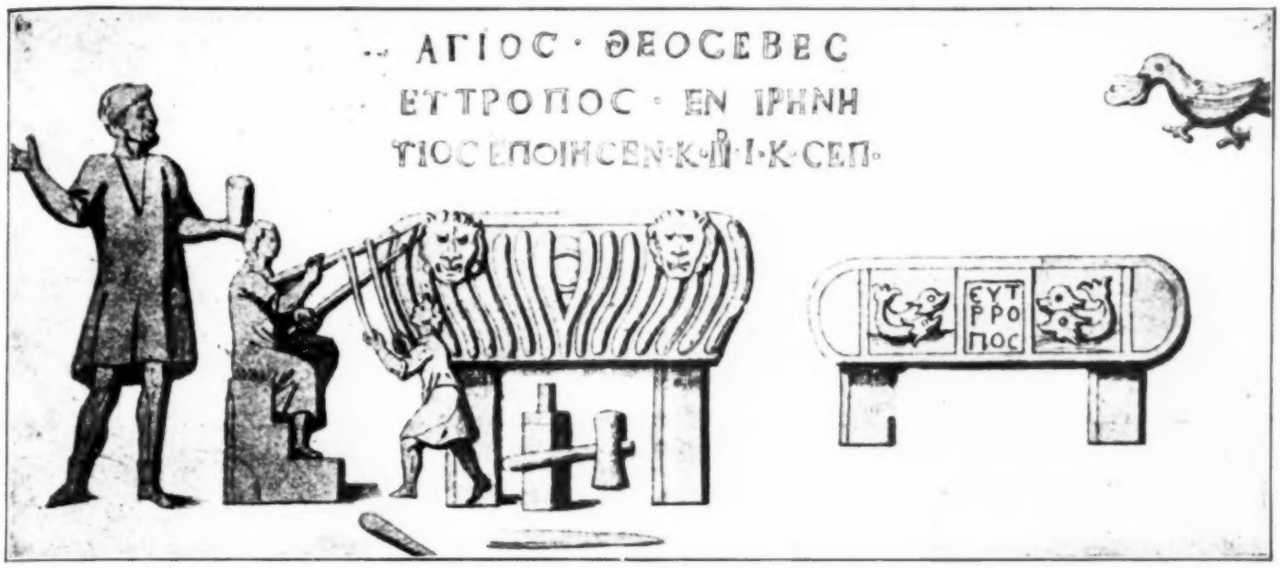
Furthermore, a designer works more than the specified number of hours set by the company. He does not lay down his ideas when the whistle blows and forget about them until the next morning. The writer has known of a number of incidents where a designer has been stumped on a certain mechanism or tool and, taking it home with him, has sat up half the night and a good part of the morning doping a way out. He neither asks nor receives any extra or overtime pay for this extra work. His pay is the satisfaction of having created an idea and having planned it in concrete form for the use of those who may benefit by it.

There are numerous draftsmen today seriously considering the advisability of changing their vocation for one which will reward them financially in proportion to the energy expended. No doubt there are numerous concerns who are seeing to it that their engineering staffs are receiving just compensation, but there are also numerous concerns who have not considered this phase of their organization when dividing profits.

The machine-tool industry is considered the basic industry and the writer believes that the engineering department is the basic department of the machine-tool industry, for in this department the idea is put into concrete form before it is built into a product.

Obtaining the right class of men for the designing of a certain product is becoming a hard task in some sections of the country. It is, therefore, to the interest of the engineering profession in general to keep as many of its technical men in the field as possible, and, in addition, to provide an incentive to prospective candidates to enter the field of engineering.

Prof. Henry B. Dirks, head of the Department of Mechanical Engineering at Michigan Agricultural College, Lansing, Mich., has asked us to correct an error in our issue of April 29. On page 961 of that issue we published an account of the new courses in Metallurgy at M. A. C. and credited it to Professor Dirks. He writes us that the author was W. H. Hildorf and that his name should have appeared at the head of the article. We take this opportunity to make the correction and to apologize to the two gentlemen in question.—Editor.



The Evolution of the Workshop—IX

By H. H. MANCHESTER

The beginning of the development of machine tools can be seen in the industrial happenings which followed the initiation of the use of water power. This time is characterized chiefly by a raising of the standard of accuracy in machine work.

(Part VIII was published in our April 22 issue.)

AT THE end of the Eighteenth and the first of the Nineteenth Century we enter upon what might be distinguished as the beginning of the machine-tool era. Before this period, while some of the slow heavy work had been done by water power, the fine work had been done almost entirely by hand, and there had been no methods combining speed and accuracy.

The rapid development of machine tools at that time was probably due, more than to anything else, to the influence of the steam engine. While this held up before the imagination vast possibilities for the application of power, it demanded far more accurate workmanship than had hitherto been customary.

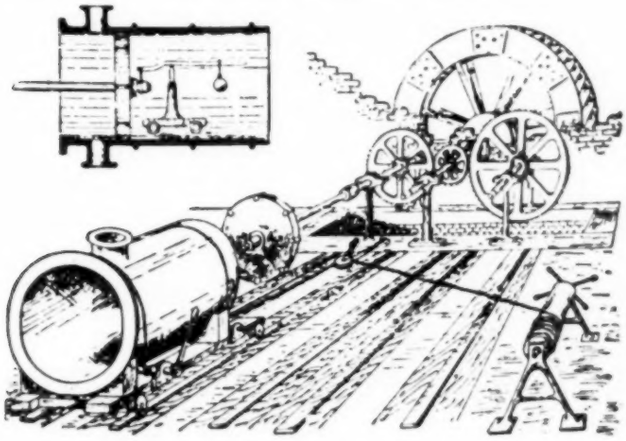


FIG. 54. SMEATON'S BORING MACHINE

Watt had the greatest difficulty in getting his cylinders bored with sufficient accuracy to permit of the use of pistons in them. A variation in diameter of half an inch throughout the length of the bore was not at all unusual. He tried all sorts of packing without much

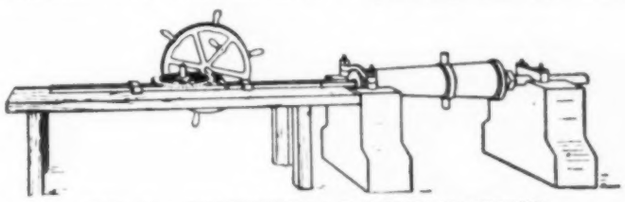


FIG. 55. WILKINSON'S BORING MACHINE

success, and it was not until he could get better boring that the triumph of his engine was assured. The first of those whose work was true enough to be dependable was John Smeaton, one of whose boring machines is reproduced, Fig. 54. It was soon improved upon by John Wilkinson, who greatly increased its accuracy by running the shank of the borer entirely through the cylinder and fixing it at the other end, as is shown by Fig. 55. This kept the borer in line instead of leaving it in the air, and made it possible to produce a cylinder whose diameter did not differ throughout its length more than the thickness of a shilling, which in these days was considered a notable feat.

Development of the Slide Rest

Probably the next highly important invention making toward accuracy was the slide rest for lathes. As has been suggested in previous articles, this was not entirely new, but it was greatly improved and applied in a far more important way.

A predecessor of the slide rest may be seen in a support for the tools used in mirror cutting mentioned by Maignan of Rome in 1648. Another is the guide for the tools used for cutting clock wheels, which was designed by Dr. Hooke in 1655. As if to emphasize the influence of clock making on the development of accurate tools, the thread cutting device for clock screws

which was invented by Hindley in 1741 had a similar rest or guide for the tools. We have likewise seen that the French Encyclopedia of Methods depicted tool rests employed in turning iron and working silver plate in 1785. None of these, however, were as yet automatic nor slid the length of the work.

Such a support for the tools is also indicated in the long patent on the methods of working wood and metals taken out by Samuel Bentham in 1793. He wrote on this subject, "When the motion is of the rotative kind, though advancement may be performed by hand, yet regularity may be more effectively insured by the aid of mechanism. For this purpose, one expedient is the connecting, for instance, by cogged wheels the advancing motion of the 'piece' with the rotative motion of the tool." Bentham included no drawings, but apparently we have here an automatic advancement without a sliding movement.

The sliding support for tools was probably added to the lathe by Henry Maudslay in 1794, while he was still working for Joseph Bramah. In his original invention, which is shown in Fig. 56, the rest was advanced to the work by a handscrew and slid along the bed by another screw, which was also turned by hand. After Maudslay left Bramah's employ to set up for himself in 1797, he improved on the supports; and by 1800 he had connected the screw that slid the support for the tools with the rotating work by means of worm-geared wheels, so that the rest slid along automatically. This device was employed particularly for the cutting of threads on bolts and screws. A machine of this type is shown in Fig. 57, while Fig. 58 is a reproduction of an old print showing the advantages of the new type of machine over the old.

The lathe, thus improved by the slide rest, was soon applied to various types of work and made possible an accuracy never before approached. For a number of years, however, it continued to be operated by hand, during which period it added little if anything to the speed and cheapness of the work.

Development of the Planing Machine

Another epoch-making advance in machine tools for working metals was the planing machine. As in the

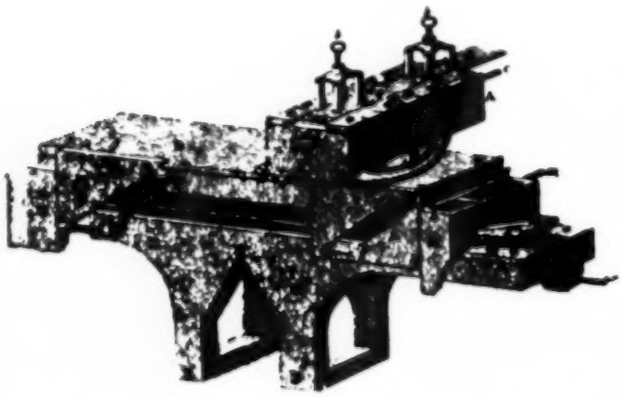


FIG. 56. SLIDE REST ON MAUDSLAY'S LATHE

case of the slide rest, this was not entirely new. In 1694 Noxon in his Mechanical Exercises mentioned a device of this sort for making brass moldings. It had a revolving cutter and a table and might be considered the first milling machine. In France a machine was invented in 1751 for planing the wrought iron barrels which were

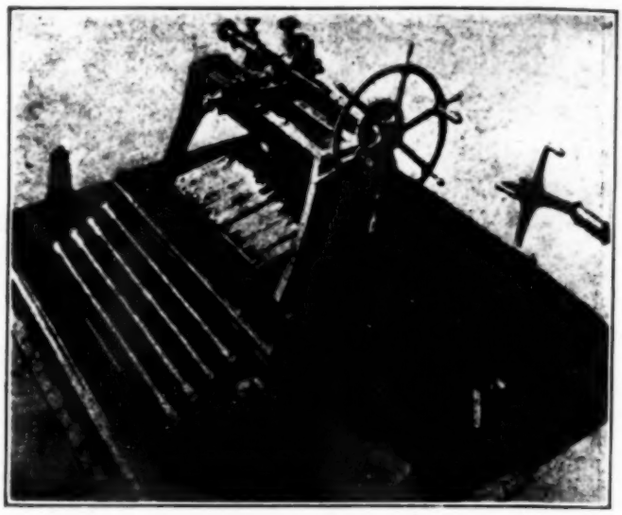


FIG. 57. A BOLT CUTTER OF 1800-1810

used at Marly. Plumier also in 1749 pictured a small crude device for the purpose.

In many respects, however, the era of the planing machine began with the patent for one taken out by Samuel Bentham in 1791. This had a reciprocating action, and was to be applied to wood, but in his patent of 1793 Bentham extends its use to metals. In 1802 a planing machine with a transverse action was patented by Joseph Bramah. This had a horizontal roughing wheel armed with gouges, followed by planing irons for finishing. It was intended for wood, but in 1811 Bramah improved on the revolving cutters and applied it to metals, thus producing practically a milling machine.

Other Planing Machines

Various other planing machines are said to have been invented or used by different machinists for working iron as early as 1814. One of these was credited to James Fox, another to Matthew Murray, a third to Joseph Clements in Bramah's shop, and still a fourth to Roberts and Rennie of Manchester. Bramah used his machine to trim the surfaces of his famous locks. In 1820 Clements was employing it to plane the sides of looms while Fox was making use of it on the bars of lace machines.

The same year Rennie supplied it with an improved movable bed, an endless screw and rack, and with a revolving tool.

One important point about the planing machine was that from the first the effort had been made in England to have it driven by power, and very early by steam power. In connection with power, it must be borne in mind that, although Watt invented his steam engine in 1767, it was at first used only for raising water from mines, and it was applied to other industries only very gradually. It was 1781 before Watt took out his patent to change the reciprocating motion which it developed into a circular one. It was 1789 before it was first introduced into cotton spinning. In 1792 John Wilkinson took out a patent to apply steam power to the rolling of iron, but it was well into the Nineteenth Century before steam power was applied generally in even the greatest machine shops.

Another great advance of this period lay in the invention of various types of wood-working machinery, which were naturally adapted, after a few changes, to the working of metal.

Bentham's patent in 1793 covers, besides planing, sawing by reciprocate motion, working by a reciprocate lathe, giving curvature by bending, working by a rotative motion of the tool, boring, mortise making, turning in a lathe, adjustment and steadiment, advancement, and clearance. The claims of this patent extended to metal as well as to wood.

Another highly important series of woodworking machines, developed by M. I. Brunel, were involved in the inventions and operations for manufacturing ships' blocks or pulleys. His block-making ideas were evolved in association with Sir Samuel Bentham. In 1801 his designs were inspected and approved, and Henry Maudslay was given the job of constructing the machinery to make the blocks. There were forty-four machines in all, and it was 1808 before Maudslay completed them, which is only one more illustration of the time required to build an industry from the ground up.

In this series were machines for mortising, a sketch of one being shown in Fig. 59, shaping, scoring, coaking and broaching, besides the more common straight and circular saws, facing lathes, drills, riveting hammers, and iron polishers. The machines were in three sets and produced seven types and 214 sizes of blocks.

Nail Making Improved

One industry that was greatly improved during this period of invention was nail making. In 1790 Thomas

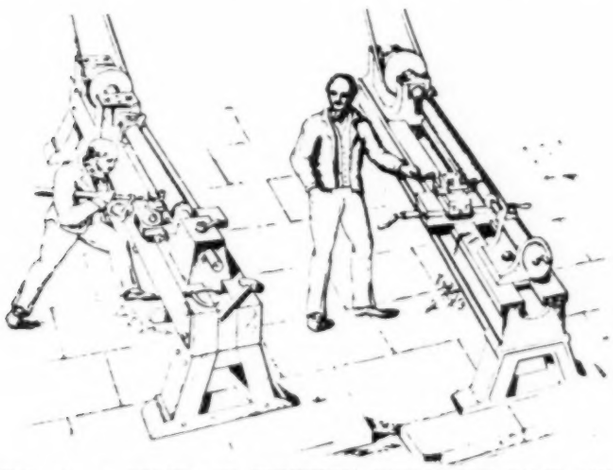


FIG. 58. A CONTRAST BETWEEN THE SLIDE REST AND THE PREVIOUS METHOD OF HOLDING TOOLS BY HAND

Clifford received a patent on a machine for pressing out nails and soon afterwards on another for rolling and cutting them out. The field was evidently a fertile one, for Clifford's machines were used in French's factory in 1792, and patents on nail making averaged one a year for the next half century.

Introduction of Metal-Working Machines

There were a number of other patents taken out at that period which give a bird's-eye view of the ideas that were developing. A good many of them were never put into actual practice, although they are interesting.

In 1783 William Playfair patented a machine for cutting and shaping metals, but it seems to have been intended for the softer types. Joseph Hately in 1790 received a patent for a pneumatic engine for rolling, slitting and stamping metals, but we do not hear of any further development in the way of an air engine for many years. A patent for rolling metal plates was taken out by John Bennoch in 1801, and one for rolling out the shanks of nails by Booth Hodgetts in 1803. A new file-cutting machine was made by William Nicholson in 1802, and a still more important one by Reichenbach in 1804. An improved vertical boring machine was developed by Billingsley in 1803, and a horizontal one by John Dixon in 1807. Circular saws seem to have been invented by someone unknown, but probably in Holland in the Sixteenth Century. The first band saw that was successful, however, appears to be that of William Newberry, which dates from 1808, and which is shown in Fig. 60. Circular shears were invented by James White in 1811. All of these machines were of course at first applied to materials other than metal. In 1808 Benjamin Cook forged iron pipe from flat bars, but only partly by machine. An important use of rollers for the purpose was begun by Henry James and John Jones in 1811.

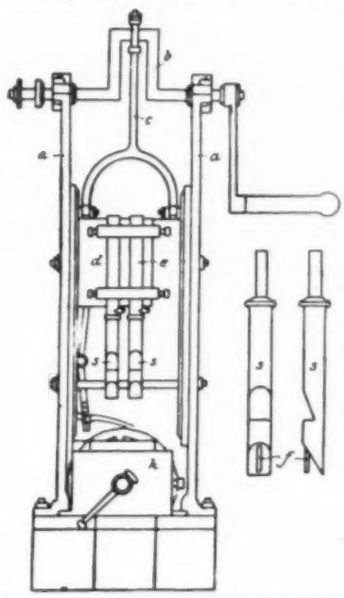


FIG. 59. MORTISING MACHINE OF BRUNEL 1801

This new method was particularly valuable in connection with the use of gas for lighting, which was just being made a success. In the same year James and Jones also patented an improved lathe for gun barrels, while another advancement in the turning of iron was claimed by Henry Osborn in 1812.

A new subject was opened up in 1815 by the invention of William Vance Palmer of a machine for twisting metal.

A Sign of Accuracy

One sign that machining had reached a far higher degree of accuracy was the fact that engines for steamboats could be built successfully, and that steam power was in 1815 just being applied with advantage to weaving. But the era of handwork had by no means passed. Most iron work was still done by hand, many of the

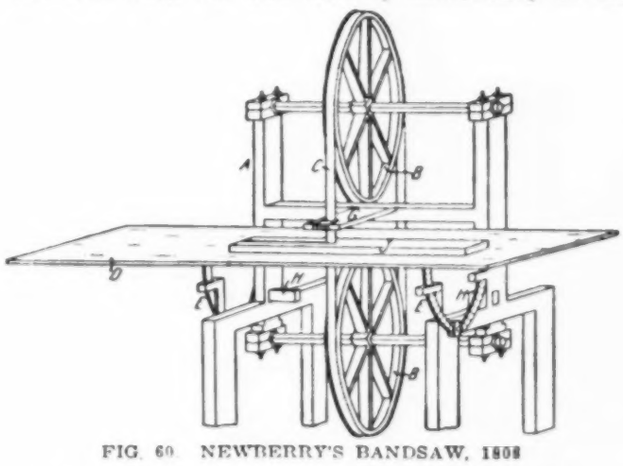


FIG. 60. NEWBERRY'S BANDSAW, 1808

so-called machines were as yet run by hand, and it was only for the heaviest operations that power was employed.

Load Characteristics of Radio-Thrust Bearings

By F. C. GOLDSMITH
Chief Engineer, New Departure Manufacturing Company

This article is a reply to that of F. W. Gurney under the above title and which appeared in vol. 50, page 1233 of the American Machinist. The author suggests that Mr. Gurney give the mathematical derivation of the formulas used in the article to which he is replying and also takes the opportunity to advance some of his own ideas on the subject.

THIS subject is one with which the writer is more or less familiar, as evidenced by a paper by him on the same subject, entitled "Load Carrying Possibilities of Angular Contact Ball Bearings," which was presented at the semi-annual meeting of the Society of Automotive Engineers held at Ottawa Beach, Michigan, June 23 to 27, 1919.

Without doubt, Mr. Gurney has given considerable time and thought to this subject as evidenced by his curve sheet, Fig. 4; but the writer for one, after having very carefully read the article, is not willing to accept Mr. Gurney's curves without first knowing more about their mathematical derivation. Undoubtedly, other engineers have the same feeling toward formulas and curves that the writer has; namely, that all steps in their derivation must be thoroughly proved before they are finally accepted. Knowing Mr. Gurney personally and realizing his ability to handle this kind of subject, I take the liberty of suggesting that he take us into his confidence and explain his reasoning and mathematical proof.

There are several points in the use of the curve, Fig. 4, which are not quite clear to me and I should like to ask about these, and at the same time, advance some of my own ideas, hoping that other engineers will advance theirs. In this manner we will learn more of this very interesting subject.

First, does Mr. Gurney believe in the original Hertz and Stribeck theory of the loading of annular or radial ball bearings, which proof considers both balls and races as elastic bodies?

Second, in the explanation of the use of the curves, Fig. 4, we are told that "These curves show the capacities of the radio-thrust bearings in percentages of the regular rated loads to carry various combinations of radial and thrust loads." If I am correct, the regular rated load means the catalog radial rated load for the particular kind of bearing in question. Therefore, why do not all three of the curves have a 100 per cent value when there is no thrust load and 100, 150 and 200 per cent values when there is only a thrust load?

In trying to analyze this point, I am inclined to believe that the pure radial values of these curves are based on an annular or radial bearing as having a 100 per cent value. But an annular bearing cannot carry much of a thrust load and if my interpretation is correct, is it right to compare an angular contact bearing under a combined load to a pure radial bearing under only a radial load?

In order to further this subject, I am requesting the *American Machinist* to insert at this point that portion of the writer's article, "Load Carrying Possibilities of Angular Contact Ball Bearings," dealing with the mathematical proof.

* * *

While the use of balls as load-carrying devices dates far into antiquity, the use of hardened-steel balls with raceways as journal bearings is of comparatively recent origin. It was only in the last quarter of the Nineteenth Century that an American invented ready means of producing steel balls in quantities at anything approaching reasonable costs and, even then, many years of experiment and research were required to devise means for producing balls of sufficiently accurate spherical form to enable them to be used in journal boxes.

Coincident with the production of spherical balls, various forms of race member were devised which, in combination, produced journal bearings of a more or less satisfactory nature, and beginning with the development of the bicycle industry, ball bearings began to be used to a large extent in various industries. Of all the early race forms that survive, the cup and cone type found widest application in the bicycle. In these bearings the race members were lightly casehardened, the balls were either casehardened or made of nature-hard steel; and while the balls themselves were highly polished the surface of the race member was but lightly polished and very seldom ground. These early applications of the ball bearing to widely distributed commercial use were subjected to very little load and, in consequence, small balls served faithfully to perform the functions required and markedly reduced journal friction as compared to any form of plain or roller bearing then extant. The success attained with ball bearings in the bicycle rapidly brought the attention of the mechanical world to their friction-saving qualities, and many attempts were made to apply the then very crude existing types to other mechanical uses.

Early Use of Ball Bearings

Very little accurate knowledge was at hand concerning the load-carrying capacities of balls or races, and many mistakes were made in the employment of too-small balls and too-thinly carburized race sections, until it became the belief among many mechanical men that the ball bearing was suited only to carrying the lightest of loads; but in the endeavor to attain the very low friction values present when balls were used in journals, early means having been discovered of testing the load-carrying values of balls themselves, larger and still larger balls were used as load-carrying members. The raceways, however, suffered very little improvement, merely being increased in size, without change in material or its treatment.

Even up to the present day, many applications exist wherein relatively light pressed steel members are employed, using large balls and subjected to heavy loads. These types of bearing are still called the cup and cone bearing. These bearings are practically always of angular-contact form, in that the load line of the ball is at an angle to the axis of the shaft, and either one or both of the race members are casehardened and in general are of inferior steels to begin with, though the balls in gen-

eral are made from most excellent steels. The race members in most of these bearings are not ground and very little attention has been paid to the proper study of race curvature and accuracy. Needless to say, the service performed by these bearings is as good as the design, materials and structure will allow. Friction is reduced by their use but not to an extent possible by the use of greater care in design, fabrication and choice of metal.

It is possible that the relatively unsatisfactory service given by the pressed-steel cup and cone bearing has caused considerably more interest in the more highly developed and technically studied annular type of ball bearing of more or less foreign origin than in the possibilities of perfection of the angular type of bearing for the performance of certain specific and well-adapted service. The angular contact, more commonly known as the cup and cone bearing, is particularly an American invention.

The annular bearing in which the journal load is applied through the balls in a line directly perpendicular to the axis of rotation and in which the balls are confined between curved raceways in accurately generated and ground race rings of the most highly perfected of alloy steels hardened throughout is properly of German origin. The technical structure of the annular bearing has received, at the hands of the German scientists, very careful analysis. Its load capacities have been subjected to most careful research, and the features of its design most accurately determined.

Analysis of Possibilities of Bearings

It is the purpose of this article to analyze the possibilities of the angular-contact (cup and cone) type of bearing when it is made as accurately as must needs be to utilize to the fullest extent the friction-reducing properties of absolutely accurate steel spheres confined between accurately generated and ground curved raceways made of steels as highly perfected and as scientifically treated as are the balls themselves, and to determine, in so far as possible, the load-carrying powers of such bearings, both for axial (thrust) loads as well as for radial loads, and to determine the law of variation of load-carrying capacity in such a bearing as the direction of the bearing load may vary from the perpendicular to the axis of rotation (pure radial load) to the axis of rotation (pure end thrust).

My development of the loading of angular-contact ball bearings considers both the balls and races as elastic bodies and develops the load-carrying possibilities in terms of the carrying power of a single ball. When we think that the balls, as well as the races, are elastic bodies, we realize at once that if we consider the actual load as divided into two component loads, one a pure radial load and the other a pure thrust load, we are working under a false premise, for the races can approach each other only in the line of action of the single load.

In the proof to follow, the load on the bearing is considered as acting in one direction at a time, and the load-carrying possibilities of the bearing are studied as the load changes its direction from a pure radial to a pure thrust load.

According to Hertz and Stribeck, for balls between raceways which have curved cross-sections closely fitting the contour of the ball, as in our present-day high-grade ball bearings:

$$\delta_0 = K\sqrt[3]{P_0^2} \qquad (1)$$

δ_0 = increment of approach of the raceways when ball is under maximum load and line of load application coincides with line of ball contact

K = a constant

P_0 = maximum load ball is subjected to

Stribeck's equation for the theoretical loading of annular or radial type ball bearings (which neglects speed factors) is:

$$P = P_0(1 + 2\cos\tfrac{5}{2}\alpha + 2\cos\tfrac{5}{2}2\alpha + 2\cos\tfrac{5}{2}3\alpha \quad . \quad . \quad . \quad + 2\cos\tfrac{5}{2}n\alpha) \qquad (2)$$

P = total journal load

α = angle in degrees between two consecutive balls

$n\alpha < 90°$

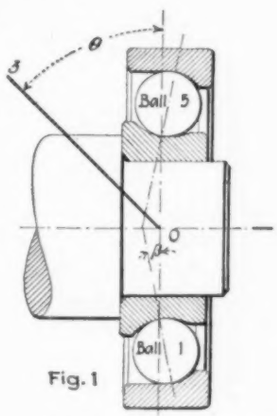


Fig. 1

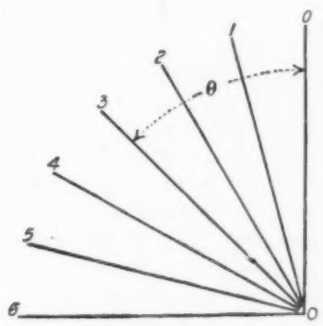


Fig. 2

FIG. 1. ANGULAR CONTACT TYPE OF BEARING
FIG. 2. LOAD POSITIONS FROM 0 TO 90 DEGREES

For a bearing containing ten balls—

$$P = \frac{n P_0}{4.38} \qquad (3)$$

For a bearing containing fifteen balls—

$$P = \frac{n P_0}{4.36} \qquad (4)$$

For a bearing containing twenty balls—

$$P = \frac{n P_0}{4.37} \qquad (5)$$

where n is the number of balls in the bearing.

For practical consideration and considering looseness of balls and spring of races—

$$P = \frac{n P_0}{5} \text{ or } P = 0.2nP_0 \qquad (6)$$

From the result of tests and experiments it has been pretty generally accepted that the load-carrying possibilities of a present-day high-grade steel ball vary directly as the square of the ball diameter; therefore P_0 bears a direct relationship to the square of the ball diameter.

Fig. 1 shows a cross-section of an angular-contact type ball bearing, β being the angle of contact. The arrow shows the direction of the load as applied to the inner race. The load is neither radial nor thrust.

Fig. 2 represents seven different positions of the load as it shifts through 90 deg., the vertical arrow marked 0 being a pure radial load and the horizontal arrow marked 6 being a pure thrust load.

Fig. 3 is a side elevation and end view of a bearing containing eight balls, but the mathematical proof to

follow considers any number of balls. The lettered arrows show the direction of the applied load as well as the direction of approach of the races with respect to the individual balls, the angle between consecutive balls being shown as α.

The heavy black arrow marked 3 in Figs. 1 and 2

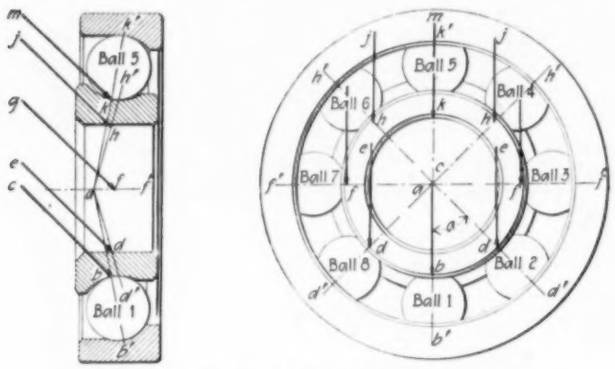


FIG. 3. BEARING HAVING EIGHT BALLS

represents any load to which the bearing may be subjected. In Fig. 3 the small arrows show how this same load acts with respect to each individual ball. When the line of action of the load $\overline{cb}$ makes an angle cbb' greater than 90 deg. with the line of contact $\overline{bb'}$ between ball and races, then the ball will carry a portion of the load. In Fig. 4 is shown the true angles between the line of ball contact and the line of load application for each of the eight balls. The angles ω_1, ω_2 *and* $_8$, ω_3 *and* $_7$, ω_4 *and* $_6$ and ω_5 represent the supplementary angles in each case, these being used in the proof, the real angles being cbb', edd', gff', jhh' and mkk'. From an inspection of these angles one can readily see that for this particular load balls 4, 5 and 6 do not carry any of the load.

Starting with a pure radial load and considering an infinite number of loads through an angle of 90 deg. to a pure thrust load, we would have one-half the number of balls under load in the radial position, and as the angle of load increased we would anticipate the maximum loading-carrying capacity of the bearing shortly after the angle of load has become greater than the con-

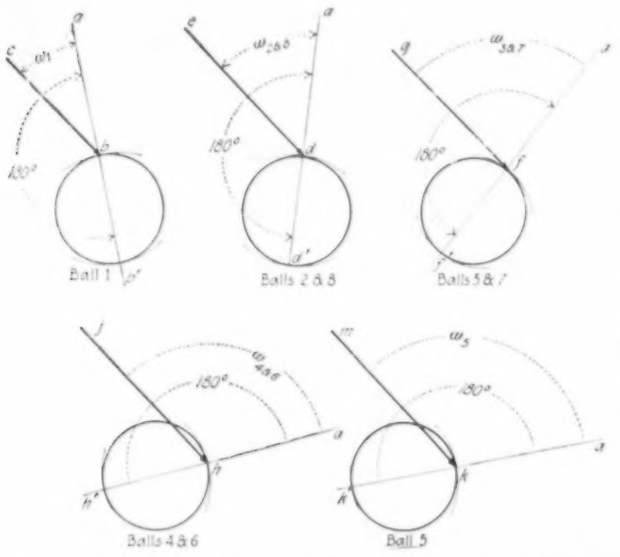


FIG. 4. ANGLES BETWEEN LINE OF BALL CONTACT AND THE LINE OF LOAD APPLICATION IN BEARING HAVING EIGHT BALLS

tact angle. When the line of load application makes an angle of β, the angle of ball contact with the arrow 6 in Fig. 2, we can understand that the last ball in the bearing is coming under load and would expect a rapid increase in the bearing carrying capacity beyond this point.

Let us consider the mathematical proof as divided into two problems, the first problem being to establish a mathematical relationship between known angles and assumed directions of load application and determine in degrees of the ball circle just when a ball will begin and leave off carrying any part of the applied load for each different direction of load application; the second problem being to establish an equation in terms of bear-

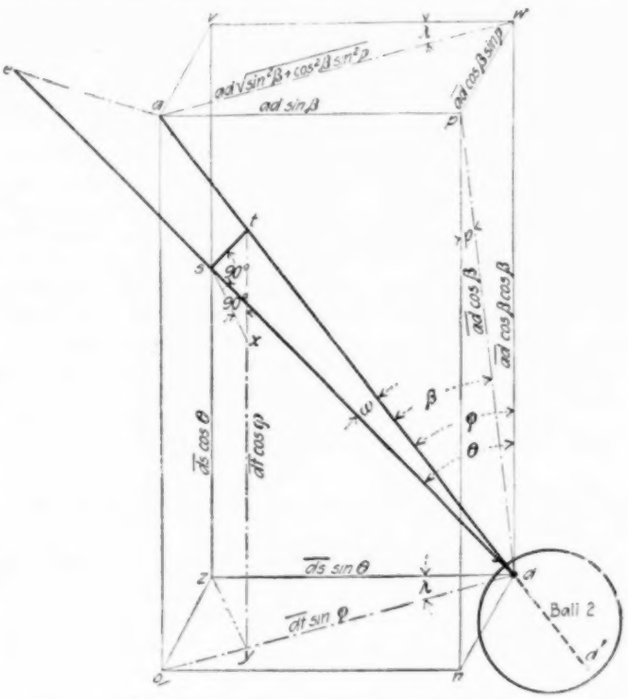


FIG. 5. CONSTRUCTION LINES TO DEVELOP MATHEMATICAL RELATIONSHIP BETWEEN DIRECTION OF LOAD APPLICATION AND ANGLE OF BALL CIRCLE THROUGH WHICH BALLS ARE LOADED

ing load, known relationships and the maximum load a ball can safely carry.

Fig. 5 shows the necessary construction lines to develop the mathematical relationships between the direction of load application and the angle of ball circle through which the balls are loaded. In the diagram the ball 2 is shown as representing any ball position other than when the line of ball contact lies in a vertical plane. Plane *pwdn* is plane of contact of all balls with the inner race or cone. Line $\overline{ap}$ is the axis of rotation of either the cup or cone (axis of shaft). Line $\overline{add'}$ is the line of ball contact extended to intersect the axis of rotation $\overline{ap}$. Line $\overline{esd}$ is the line of load application as applied to any ball. Plane *vwdz* is perpendicular to the plane of ball contact *pwdn* and contains the line of load application $\overline{esd}$.

Angle β is the angle of ball contact. Angle θ is the angle of load application (angle between load application line and plane of balls and cone contact *pwdn*). Angle φ is one-half of that portion of the ball center circle through which any ball carries a part of the load and varies with the angle θ.

Angle ω is the supplement of the angle between the line of load application and the line of ball contact. It can vary between 90 and 0 deg., the ball carrying no load when ω equals 90 deg. and a maximum load when ω equals 0 deg.

To establish relationship of angle ω, let

$$\overline{ty} = \overline{td} \cos \phi$$

$$\overline{sz} = \overline{sd} \cos \theta$$

$$\overline{tx} = \overline{ty} - \overline{sz} = \overline{td} \cos \phi - \overline{sd} \cos \theta$$

$$\overline{zd} = \overline{sd} \sin \theta$$

$$\overline{yd} = \overline{td} \sin \phi$$

$$\overline{sx} = \overline{zy} = \sqrt{\overline{zd}^2 + \overline{yd}^2 - \overline{zd}\ \overline{yd} \cos \lambda}$$ by trigonometry

$$\overline{sx} = \sqrt{\overline{sd}^2 \sin^2 \theta + \overline{td}^2 \sin^2 \phi - 2\ \overline{sd}\ \overline{td} \sin \theta \sin \phi \cos \lambda}$$

$$\overline{st} = \sqrt{\overline{tx}^2 + \overline{sx}^2}$$

$$\overline{st} = \sqrt{\overline{td}^2 \cos^2 \phi - 2\ \overline{td}\ \overline{sd} \cos \phi \cos \theta + \overline{sd}^2 \cos^2 \theta + \overline{sd}^2 \sin^2 \theta + \overline{td}^2 \sin^2 \phi - 2\ \overline{sd}\ \overline{td} \sin \theta \sin \phi \cos \lambda}$$

$$\overline{st} = \sqrt{\overline{sd}^2 (\sin^2 \theta + \cos^2 \theta) + \overline{td}^2 (\sin^2 \phi + \cos^2 \phi) - 2\ \overline{sd}\ \overline{td} (\sin \theta \sin \phi \cos \lambda + \cos \phi \cos \theta)}$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\ \overline{sd}\ \overline{td} (\sin \theta \sin \phi \cos \lambda + \cos^2 \phi \cos \theta)}$$

$$\overline{wd} = \overline{pn} = \overline{pd} \cos \rho = \overline{ad} \cos \beta \cos \rho$$

$$\cos \phi = \frac{\overline{wd}}{\overline{ad}} = \frac{\overline{ad} \cos \beta \cos \rho}{\overline{ad}} = \cos \beta \cos \rho \qquad (8)$$

$$\overline{vw} = \overline{ap} = \overline{ad} \sin \beta$$

$$\overline{aw} = \overline{ad} \sin \phi$$

$$\cos \lambda = \frac{\overline{vw}}{\overline{aw}} = \frac{\overline{ad} \sin \beta}{\overline{ad} \sin \phi} = \frac{\sin \beta}{\sin \phi} \qquad (9)$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\ \overline{sd}\ \overline{td} (\sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta)} \qquad (10)$$

$$\overline{st} = \sqrt{\overline{sd}^2 + \overline{td}^2 - 2\ \overline{sd}\ \overline{td} \cos \omega} \qquad (11)$$

$$\cos \omega = \sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta \qquad (12)$$

$$\therefore \omega = \text{arc cos } (\sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta) \qquad (13)$$

Angle ρ can be considered as being made up of multiples of the angle α.

Equations (12) and (13) show the relationship existing between ω, θ, β and ρ. For any angular-contact ball bearing having a given number of balls and a fixed angle of contact, the angle β is known. If we consider angle θ as varying from 0 to 90 deg. or from a pure radial to a pure thrust load, it would be entirely possible to establish for each value of θ the corresponding value of 2ρ in degrees of the ball center circle, through which a ball would carry a portion of the load; for when ω becomes 90 deg. the ball ceases to carry any of the total load. Knowing the number of balls in the bearing, angle α is known and we can at once find how many balls are under load for each corresponding value of the angle θ.

Using the above established relationships, we have the final problem to establish an equation for the load-carrying possibilities of an angular-contact type ball bearing in terms of known quantities. In this case, let

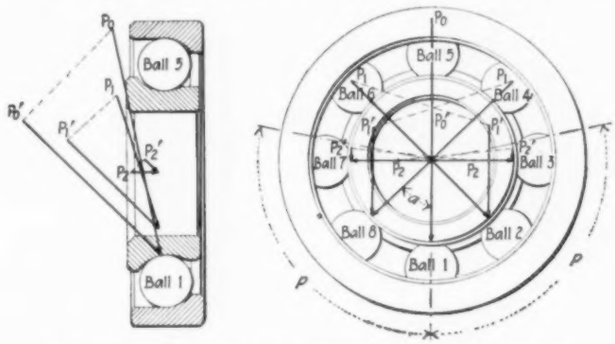


FIG. 6. DIRECTION OF INDIVIDUAL BALL LOADS

P = Total resultant load on one ball row
P_o' = Load on bottom ball in direction of load
P_o = Load on bottom ball in direction of contact
P_1' = Load on next ball in direction of load
P_1 = Load on next ball in direction of contact.
δ_o' = Approach of races at bottom ball in direction of load
δ_o = Approach of races at bottom ball in direction of contact
δ_1' = Approach of races at next ball in direction of load
δ_1 = Approach of races at next ball in direction of contact
α = Angle between balls in vertical plane
β = Angle of contact
θ = Angle between line of load application and plane of balls
ω = Angle between line of load application and contact lines

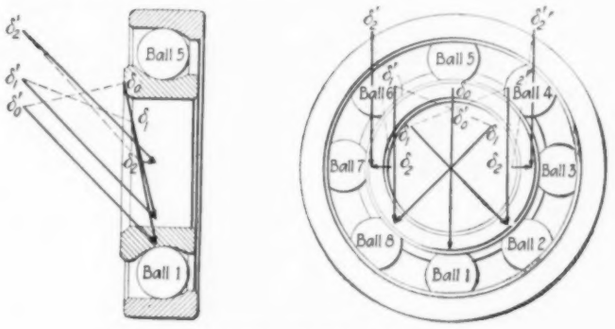


FIG. 7. APPROACH OF BALL RACES

From equation (12),

$$\cos \omega = \sin \theta \sin \beta + \cos \beta \cos \rho \cos \theta$$

Referring to Fig. 6, which shows direction of individual ball loads

$$P = P_o' + 2P_1' + 2P_2' + \ldots\ 2P_n' \qquad (14)$$

$$P_o' = P_o \cos \omega_o = P_o (\sin \theta \sin \beta + \cos \theta \cos \beta) = P_o \cos (\theta - \beta) \qquad (15)$$

$$P_1' = P_1 \cos \omega_1 = P_1 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha) \qquad (16)$$

$$P_3' = P_3 \cos \omega_3 = P_3 \ (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2\alpha) \quad (17)$$

Referring to Fig. 7, which shows approach of races:

$$\delta_0 = \delta_0' \cos \omega_0 = \delta_0 \cos (\theta - \beta) \quad (18)$$

$$\delta_1 = \delta_1' \cos \omega_1' = \delta_1' (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha) \quad (19)$$

$$\delta_2 = \delta_2' \cos \omega_2 = \delta_2' (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2\alpha) \quad (20)$$

Also,

$$\delta_0' = \delta_1' = \delta_2' = \ldots \delta\eta' \quad (21)$$

From Hertz:

$$\frac{P_0^2}{\delta_0^3} = \frac{P_1^2}{\delta_1^3} = \frac{P_2^2}{\delta_2^3} = \ldots \frac{P\eta^2}{\delta\eta^3} \quad (22)$$

$$\frac{\delta_0}{\cos \omega_0} = \frac{\delta_1}{\cos \omega_1} = \frac{\delta_2}{\cos \omega_2} = \ldots \frac{\delta\eta}{\cos \omega_\eta} \quad (23)$$

$$\delta_1 = \frac{\cos \omega_1 \ \delta_0}{\cos \omega_0}$$

$$P_1^2 = \frac{\delta_1^2 P_0^2}{\delta_0^2} = \frac{\cos^2 \omega_1 \ \delta_0^2 P_0^2}{\cos^2 \omega_0 \ \delta_0^2} = \frac{\cos^2 \omega \ P_0^2}{\cos^2 \omega_0} \quad (24)$$

$$\therefore P_1 = \frac{\cos \frac{3}{2} \omega_1 \ P_0}{\cos \frac{3}{2} \omega_0} \text{ and} \quad (25)$$

$$P_2 = \frac{\cos \frac{3}{2} \omega_2 \ P_0}{\cos \frac{3}{2} \omega_0} \quad (26)$$

By substitution equation 14 becomes

$$P = P_0 \cos \omega_0 + 2P_1 \cos \omega_1 + 2P_2 \cos \omega_2 + \ldots 2P\eta \cos \omega_\eta \quad (27)$$

$$P = P_0 \cos \omega_0 + \frac{2 P_0 \cos \frac{5}{2} \omega_1}{\cos \frac{3}{2} \omega_1} + \frac{2 P \cos \frac{5}{2} \omega_2}{\cos \frac{3}{2} \omega_0} + \ldots \frac{2 P_0 \cos \frac{5}{2} \omega_\eta}{\cos \frac{3}{2} \omega_0}$$

Where η is such that $\cos \omega_\eta = 0$

$$P = P^0 \left(\cos \omega_0 + \frac{2 \cos \frac{5}{2} \omega_1}{\cos \frac{3}{2} \omega_0} + \frac{2 \cos \frac{5}{2} \omega_2}{\cos \frac{3}{2} \omega_0} + \ldots \frac{2 \cos \frac{5}{2} \omega_\eta}{\cos \frac{3}{2} \omega_0} \right)$$

$$P = P_0 \left[\cos (\theta - \beta) + \frac{2 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha)^{\frac{5}{2}}}{\cos \frac{3}{2} (\theta - \beta)} + \frac{2(\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2\alpha)^{\frac{5}{2}}}{\cos \frac{3}{2} (\theta - \beta)} + \ldots \frac{2 (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \eta\alpha)^{\frac{5}{2}}}{\cos \frac{3}{2} (\theta - \beta)} \right]$$

$$P = P_0 \left\{ \cos (\theta - \beta) + \frac{2}{\cos \frac{3}{2} (\theta - \beta)} \left[(\sin \theta \sin \beta + \cos \theta \cos \beta \cos \alpha)^{\frac{5}{2}} + (\sin \theta \sin \beta + \cos \theta \cos \beta \cos 2\alpha)^{\frac{5}{2}} + \ldots (\sin \theta \sin \beta + \cos \theta \cos \beta \cos \eta\alpha)^{\frac{5}{2}} \right] \right\} \quad (28)$$

As a check let θ and β become 0 as in a radial bearing, then

$$P = P_0 [1 + 2 (\cos^{\frac{5}{2}} \alpha + \cos^{\frac{5}{2}} 2\alpha + \ldots \cos^{\frac{5}{2}} \eta\alpha)]$$

$$P = P_0 (1 + 2 \cos^{\frac{5}{2}} \alpha + 2 \cos^{\frac{5}{2}} 2\alpha + \ldots 2 \cos^{\frac{5}{2}} \eta\alpha)$$

which is the same as Stribeck.

Referring to equation (28) we can readily see that for any one value of the load angle θ all other quantities are known and by solving this equation for bearings containing ten, fifteen and twenty balls, and letting θ vary through 90 deg., we shall arrive at a variable factor which has a fixed value for each corresponding value of θ. Plotting these values of the variable factor against degrees of the angle of load application θ through 90 deg., we have a curve from which, when we know the angle of load application, we can pick the proper value of one of the principal bearing load factors.

In Fig. 8 we have a curve showing the variable factor K as ordinates against values of the load angle θ as abscissa for a very popular line of 100 per cent thrust angular-contact type of ball bearing. The values of K are the average of bearings having 10, 15 and 20 balls. Referring to equation (5) we have the reciprocal of the number 0.229, which is the average value of the constant from the Stribeck equation for radial or annular ball bearings having ten, fifteen and twenty balls. The

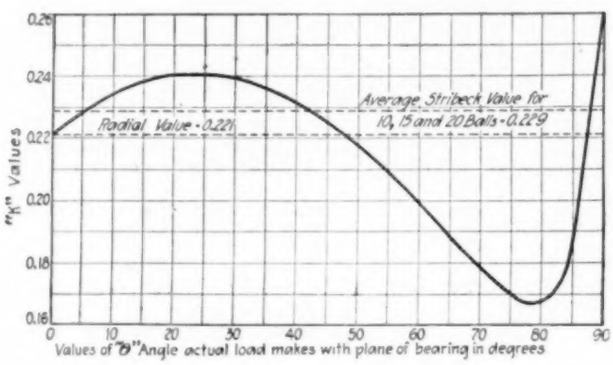


FIG. 8. CURVE SHOWING VARIABLE FACTOR AGAINST VALUES OF LOAD ANGLE

value 0.229 represents in the Stribeck equation for annular bearings, the same factor as the variable factor K represents for this particular make of annular-contact type ball bearing.

As a matter of passing interest, we have shown in Fig. 8 this value of 0.229 as a dotted line to bring out the fact that for some load angles this bearing will carry a greater load than the same size of annular bearing can carry even as a pure radial load.

Just a few words describing the use of the curve, Fig. 8. All speed load catalog ratings are given as pure radial loads, and the corresponding value of K would be 0.221. Now, supposing the angle of load application happens to be 25 deg., the corresponding value of K would be 0.24, and in selecting the proper size bearing from the catalog rating we would multiply the resultant load by 0.221 over 0.240 or

$$\text{Catalog Load} = \frac{0.221}{0.240} \times \text{Resultant}$$

$$\text{Load} = 0.92 \times \text{Resultant Load}$$

In case the load angle proved to be 85 deg.

$$\text{Catalog Load} = \frac{0.2210}{0.1675}$$

$$\times \text{ Resultant Load} = 1.32 \times \text{Resultant Load}$$

After a careful study of this curve we can see that when the load angle is less than 48 deg. we really have in this angular-contact type ball bearing a very excellent load-carrying device.

* * *

Fig. 9 shows three different curves plotted in accordance with Mr. Gurney's curve for a 100 per cent radio-thrust bearing with the one exception that the radial

values start at 100 per cent or the radial value for a 17½-deg. contact angle, angular contact bearing (which contact angle we assume to be correct for the Gurney 100 per cent radio-thrust bearing). **Curve *A*** is Mr. Gurney's curve corrected to 100 per cent for both pure radial and pure thrust loads. Curve *B* is a curve derived from formula 27 of the writer's article, which formula does not consider the effect of elasticity. Curve *C* is a curve derived from formula 28 of the writer's article using a 17½-deg. contact angle

Fig. 10 is really a very interesting curve sheet, in that after the radial and thrust loads are once determined, one can readily arrive at the proper bearing size. Under curves *A*, *B* and *C*, which correspond to the same lettered curves in Fig. 9, we have percentage curves which show at a glance what the percentage factor is for any particular combination of radial and thrust loads and

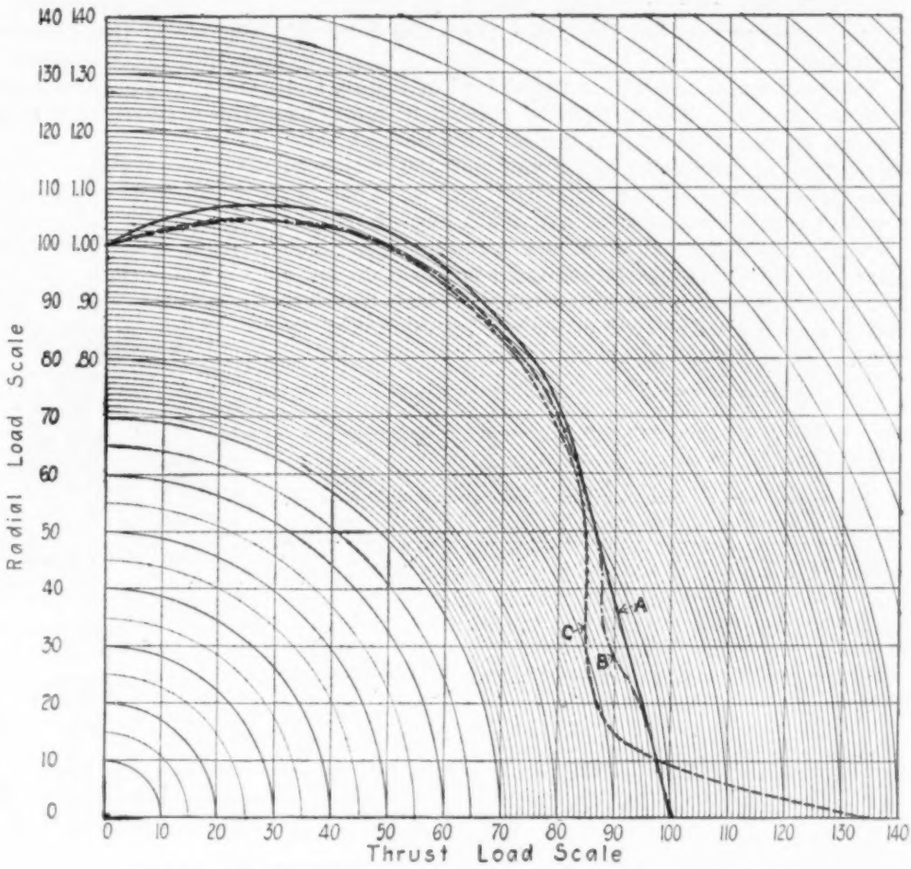


FIG. 9. CURVES FOR 100 PER CENT RADIO-THRUST BEARING

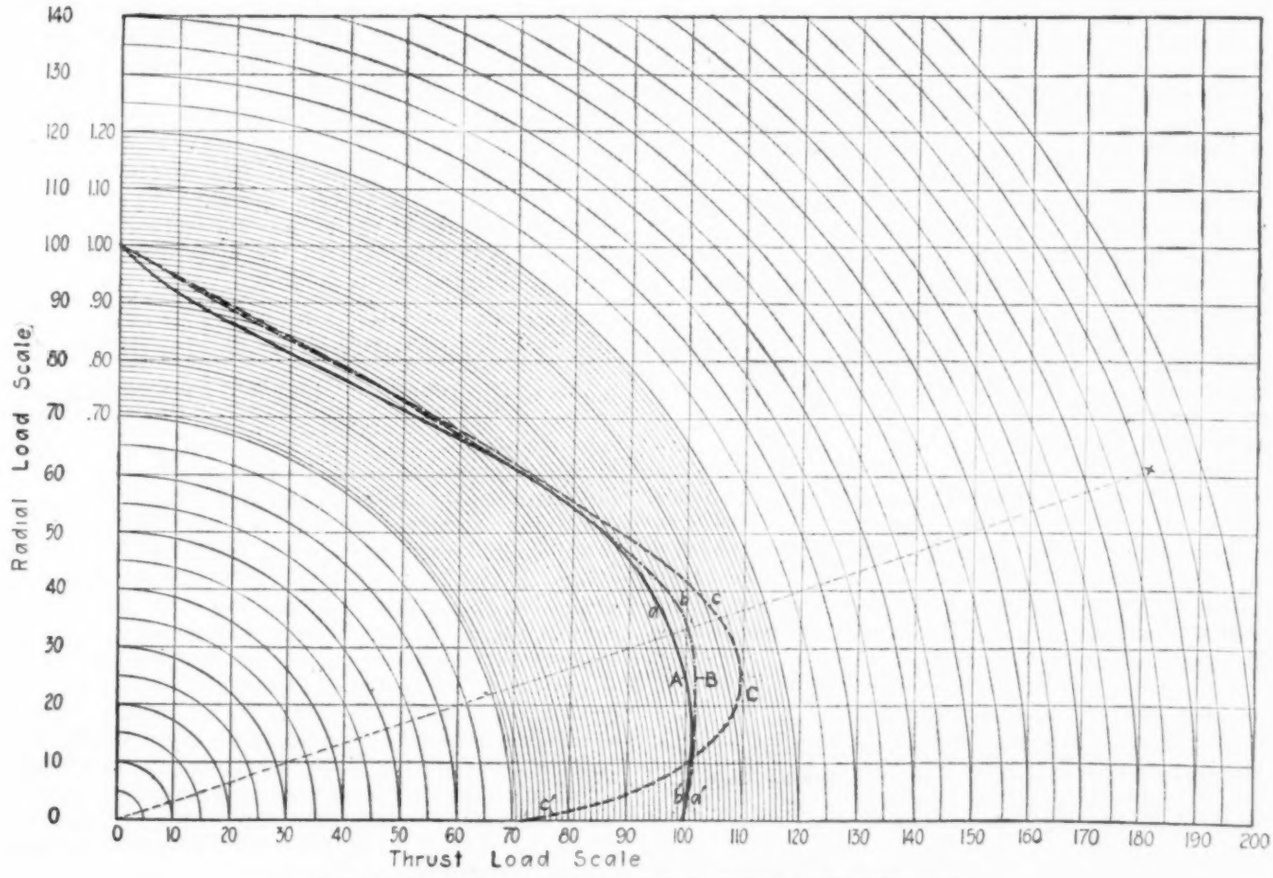


FIG. 10. CHART FOR DETERMINING PROPER BEARING SIZE

by which the resultant load should be multiplied to pick the proper bearing from the catalog radial rated load.

To use these curves with a radial load of 600 lb. and a thrust load of 1,800 lb. find the point x in a similar manner as described by Mr. Gurney; the nearest polar curve passing this point has a value of 190, which at once tells us we have a combined load of 1,900 lb. Connect points o and x with a straight line which cuts curves A, B and C at a, b and c respectively. The nearest polar curve passing through points a, b and c are 1.03, 1.06 and 1.116 respectively. Now, to select the proper size bearing, multiply the resultant load by the factor in the accompanying table.

Curve	Point on Curve	Factor	Resultant Load	Catalog Bearing Rating, lb.
A	a	1.03	1,900	1,957
B	b	1.06	1,900	2,014
C	c	1.116	1,900	2,120

For Pure Thrust Load of 1,800 Lb.

Curve	Point on Curve	Factor	Thrust Load	Catalog Bearing Rating, lb.
A	a^1	1.00	1,800	1,800
B	b^1	0.996	1,800	1,793
C	c^1	0.725	1,800	1,305

The question still remains—which of the three curves is correct?

Dies for Producing a Valve-Spring Washer

By W. A. Flumerfelt

Through experiments to overcome difficulties in the manufacture of a valve-spring washer, such as is used on the valve stems of automobile motors, the press tools here described were evolved. The number of operations were reduced from four to two, and the appearance of the resulting article was improved to a point where it is described as being "snappy" because of its flat surfaces, sharp corners and burnished edges. Dead soft, cold-rolled, sheet steel, 0.125 in. thick, is used. Annealing between operations is eliminated by the use of the dies. The piece is shown in Fig. 1.

Blanking, piercing and first forming are performed in the tools shown in Fig. 2. The blanking die A is mounted on the machine-steel holder B which serves as a guide for the draw ring C and holds the removable piercing die D. The parts mentioned form a unit which can be taken out of the die shoe for repairs or renewal by removing three screws, one of which is shown at E.

Spring pressure for drawing and ejecting is obtained by the use of the conventional rubber pad or helical spring beneath the die, and is transmitted to the draw ring through the spring pins F. The blanking punch G is also the drawing die. A hole through the center guides the piercing punch H, which is mounted on the positive knockout rod I. Thus, H and I combine to make the piercing punch and knockout. Stripping the piece from the punch is accomplished by so proportioning the parts of the die that the center hole is pierced before the shell has been drawn to its full depth. As the drawing of the shell is continued after the center has been pierced, the metal is drawn or stretched away from the punch, thus being cleared. The ejection from the upper die is made by contact of the shoulder of the punch with the shell, which is forced out of the upper die on the upward stroke of the press. The necessity for a spring stripper on the punch is

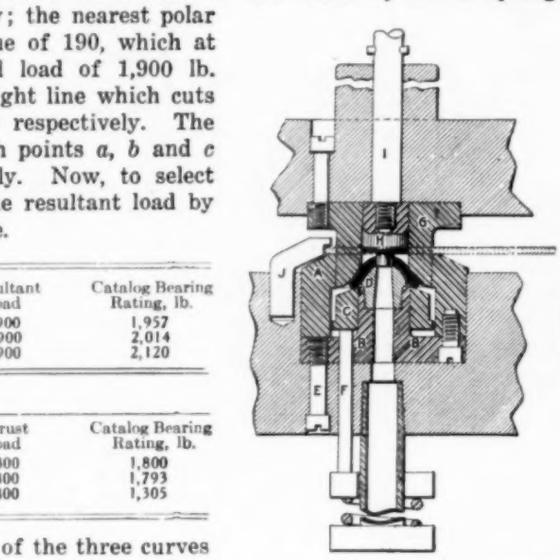


FIG. 1. A DRAWN STEEL WASHER

FIG. 2. BLANKING, FORMING, AND PIERCING DIES
FIG. 3. THE SWAGING TOOLS

eliminated by the use of three stripping fingers, one of which is shown at J. The final operation is performed by the swaging tool, Fig. 3. The two hardened-tool-steel rings K and L form the swaging die. These are retained by the machine-steel ring M. This sectional construction permits the use of ground surfaces with sharp internal corners on the die, and the machine-steel retaining ring M, which receives the retaining screws, does away with the necessity of weakening the rings K and L by tapping holes in them.

The swaging punch N is ground concave on the face indicated at O to insure the flat surface on the finished washer. The concavity of this face is determined by trial. The edge P on the die ring K produces a mirror finish on the edge of the work. The work sticks to the die and ejection is made on the upward stroke of the press by the positive knockout Q.

Brittleness in Sheet Lead

Cases of brittleness in sheet lead have recently been studied by the Bureau of Standards. Effects of corrosion sometimes transform sheet lead into a brittle, granular condition, which has often been supposed to be chargeable to allotropic transformation resulting in something analogous to the well-known "gray tin." Metallographic examination of such brittle lead by Henry S. Rawdon now has shown that the individual grains of the brittle lead are the same as those of ordinary lead, but the intercrystalline cohesion of the grains is abnormally low. Corroding agents attack the impurities in the metal, which lodge chiefly between the grains, and possibly also attack the presumptive "intercrystalline cement." Specimens of exceptionally pure lead (99.993 per cent) immersed for 24 days in a neutral solution of lead acetate became appreciably embrittled by minute intercrystalline fissures. No evidence was found that there is an allotropic form of lead or anything similar to "gray tin."—*Engineering News-Record.*

The Cost of Labor in Germany

SPECIAL CORRESPONDENCE

Some information of more than passing interest is contained in this article, which discusses wages in Germany at present. Since the author collected the facts at first hand, the article gives a very accurate idea of industrial conditions in Germany today.

DURING the war, labor was so scarce and continuous working at high pressure of such importance that the remuneration of the workmen went up on a steep line. Wages for a fully trained man, like a skilled lathe hand, were, before the war, on the average six marks for a day of 10 workng hours. Men of this class earned during the war easily 20 to 30 marks and even more by piece-rate payment. Employers did not dispute the ever-increasing demands, as they found easy recompensation in the higher prices which they got without difficulty, if only the work was done.

Such were the conditions when the war came to an end abruptly and the revolution set in. It was, of course, impossible for the manufacturers to pay wages as lavishly as had become the habit during the war. On the other hand, the workmen were not willing to climb down, but demanded an adjustment of wages on the basis of the piece-rate earnings which they were then making. They endeavored to establish the principle that they should be paid for an eight-hour day, and at a fixed payment per hour, as much as they received in a day then. As they were backed by the government and were practically in control of the country, they were able to make good their claims. Payment of piece-rates was abolished almost throughout the country. Only a few shops with an old, faithful staff of workmen were able to continue piece-rate payment in secrecy.

The Formation of Wage Agreements

From that time originated the great labor dispute which held the country in its spell during the best part of last year. It seemed impossible for quite a while to bring about a settlement. Factory owners were inclined to go out of business and sell out. Many of them would have done it, if they had found anyone ready to buy their property. The workmen had no ear for the arguments of the factory owners, not believing their protestations that they were on the point of ruin.

During the second part of the last year, however, a marked change took place. Several unsuccessful strikes, especially the noteworthy strike of the Berlin metal-working industry, which was really a test of the strength of the opposing forces, made the workmen realize the situation of industry and their own position. They became amenable to terms with the employers. In all parts of the country negotiations for the establishment of a regular schedule of wages were taken in hand and brought to a successful conclusion, both with and without outside pressure from the government.

The arrangements made between workmen and employers are local and vary greatly in the different parts of the country, since the cost of living was taken into consideration. They are made in the shape of agreements, compulsory for both parties for a certain pre-arranged time, during which they are not permitted to be disturbed by new demands or strikes. If a party desires to revise these arrangements, notice has to be given in due time.

Present Wage Schedules

The wage schedules have been made on the basis of payment per hour, the workmen having been strongly opposed to piece-rate payment until quite recently. Only during the last months they have been won over to it step by step. The accompanying table shows the schedule of wages of the principal classes of workmen in the engineering industry in a number of German towns and districts. The figures represent the minimum wages per hour in marks and fractions of marks. The actual wages are higher by about 10 or 15 per cent. Great differences exist between the wages in large towns and rural districts, as is apparent in the case of the Sieg district in comparison with Cologne or Düsseldorf.

It is noteworthy that, although Berlin is the town of highest living cost, the wages paid there are below those of Cologne and some other towns. Workmen in Berlin, however, receive extra payment in the shape of a premium, which is 6 marks a week for the unmarried and 9 marks for the married. If there are children the premium is increased by 6 marks for each child. Females receive 6 marks per week and juveniles 4 marks.

As the average earnings per hour in pre-war times

TABLE SHOWING THE MINIMUM WAGES PAID TO MECHANICS IN DIFFERENT PARTS OF GERMANY, ACCORDING TO RECENT WAGE AGREEMENTS

Minimum Wages per Hour in Marks

	Berlin	South Germany			Westphalia		Saxony		Rhineland		
		Mannheim	Munich	Nuremberg	Hagen District	Sieg District	Leipsic	Dresden	Cologne	Düsseldorf	Saarbrücken
Trained machinist	2.90—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.80	2.50—2.80	1.90—2.50
Machinist's helper	2.90—3.10	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.58	2.50—2.70	1.60—2.05
Lathe hand	2.90—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.80	2.50—2.80	1.90—2.50
Tool makers	3.40—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	3.90	2.70—2.80	1.90—2.50
Fitters	3.10—3.60	3.20	3.30	3.15	3.60	2.40	3.20	2.40	....	.....	1.90—2.50
Planer, miller and drill hands	2.70—3.10	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.80	2.50—2.80	1.60—2.05
Turret lathe and automatic operator	3.20—3.60	3.00	2.90	2.85	3.30	2.15	2.95	2.00	3.57	2.50—2.80	1.60—2.05
Females	1.70—1.90	1.70	1.65	1.40	2.05	1.30	1.70	1.20	2.00	2.05—2.25	0.85—1.00
Apprentices and Juveniles:											
First year	0.35—0.40	0.50	0.40	0.45	0.40	0.30	....	....	0.40	.....	.....
Second year	0.50—0.60	0.75	0.50	0.60	0.60	0.45	....	....	0.60	.....	.....
Third year	0.70—0.80	1.00	0.60	0.85	0.90	0.75	....	....	0.90	.....	.....
Fourth year	0.90—1.00	....	0.80	0.95	1.20	1.00	....	....	1.50	.....	.....

had been 50 to 60 pfennigs, the increase since then amounts to from 500 to 700 per cent, which is considerably more than in other countries. The position of the German manufacturers would be very difficult indeed, if the increase in cost of labor was not counterbalanced twice or three times by the depreciation of the German money. Fully trained machinists earn in a week of 45 working hours in rural districts about 125 marks and in large towns about 195 marks. While these are high figures to those accustomed to the wages paid in Germany before the war, they will appear ridicuously low if expressed in dollars. At the rate of exchange existing at the time of writing, machinists earn about $1.40 to $2.20 a week. Lathe hands get from 100 to 200 marks a week, or about $1.20 to $2.40. Planer, miller, and drill hands and turret lathe and automatic operators earn from 85 to 195 marks per week, corresponding to $1 to $2.20, while females are paid 65 to 115 marks or 75c. to $1.30 weekly.

These figures reveal the strong position that German industry holds now in the markets of the world. The advantage of the low cost of labor did not become so very marked during the first half of last year, as the efficiency of the workmen was much lower. It was commonly estimated that the efficiency of the workman was only one-third to one-fourth part of that before the war. The actual wages paid in relation to the work done were consequently higher than appeared on paper. The workmen were idling a good deal in the shops, and most of their energy was absorbed by political discussions. A change in these conditions set in last summer. The efficiency of the workmen increased and their opposition against piece-rate payment vanished. At present, payment according to results is re-established in the large majority of all German factories. While the circumstances did not bring the workmen's efficiency up to the old standard, it has risen steadily and can be said now to be about half of what it used to be. The labor question may now be considered to be settled. The evolution of the cost of labor has, of course, not come to a standstill, but it has been steadied.

It is an open secret that the German manufacturers are now making large profits, much more so than during the war. Those profits are, however, not as large as they would appear on the face of it, and the manufacturers do not have it all their own way. There is considerable discontinuity in the flow of materials coming into the factories, and the coal supply is sorely lacking. The shops have to pause quite frequently, sometimes for weeks, waiting for coal or raw material, while the expenses are running on. All efforts of the country are concentrated to bring about an improvement in this respect; but, as a large part of the German coal output and of the production of raw material has to be exported, the scarcity is very likely to be perpetuated unless help comes from outside.

I told Harry in the assembly department to make me up a sketch of a proposed change in the department and to mark up the position of the benches, machines and aisles.

In due time his sketch came to my desk and he had very carefully made it up but had spelled AISLE without the first letter; making it ISLE. I called the attention of one of the clerks in the office to it who looked it over carefully and remarked, "I don't see what the H——l he put the S in for." E. F. CREAGER.

Excess of Imports Over Exports Now Inevitable

That war loans to belligerent nations, the repurchase of American securities, and the development of our merchant marine have revolutionized our ordinary ideas of what constitutes a "favorable" foreign trade, was the assertion of George E. Roberts, vice president of the National City Bank of New York, in an address delivered May 12 before the National Foreign Trade Convention at San Francisco.

"During the ten years preceding the outbreak of the war," said Mr. Roberts, "the average annual balance of trade in favor of the United States on merchandise account was approximately $500,000,000, and it was practically offset by the balance in what has been called the invisible account.

"It is evident that the war has disturbed this old state of equilibrium. We have bought back most of the American securities which were held abroad and the interest and dividends upon them hereafter will remain at home. We are building a great fleet of merchant ships with the intention of carrying a larger portion of the overseas trade, and we have become creditors to Europe in a very large amount. Including the loans of the United States Government to the governments associated with it in the war, the balance in our favor upon interest account is doubtless considerably above $500,000,000 per annum.

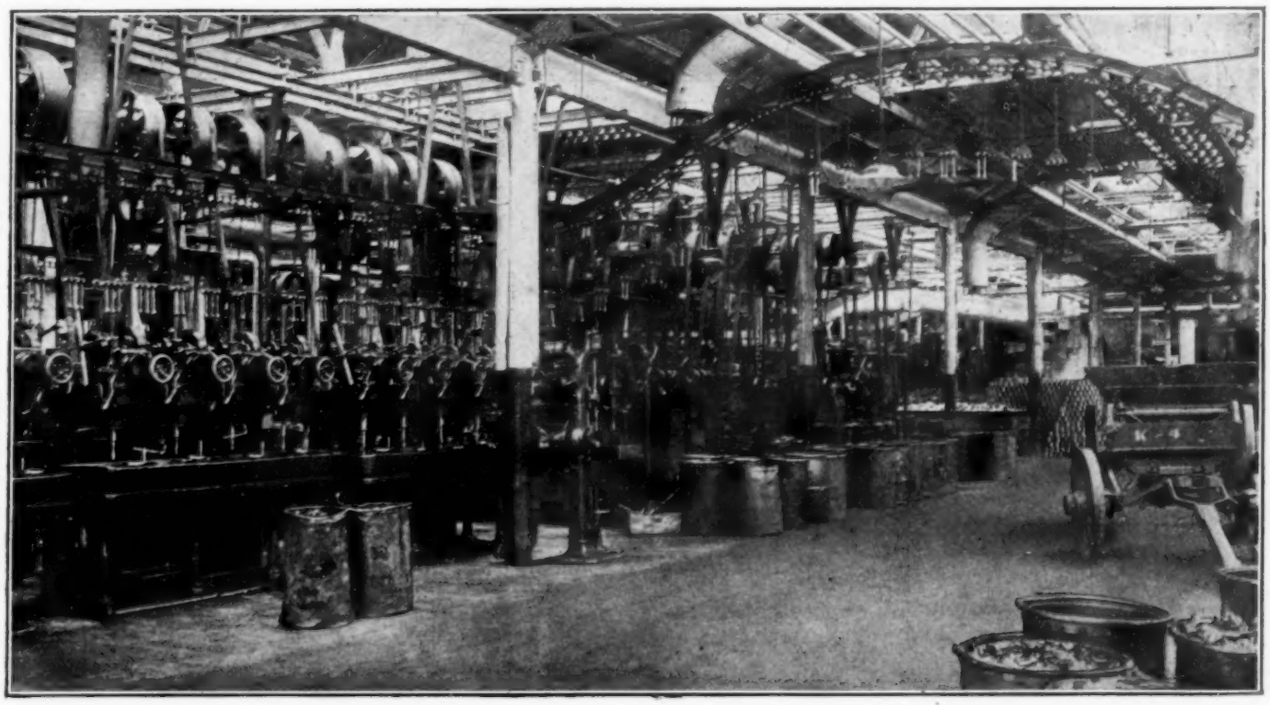
"What effect will this shift of the balance of payments in the 'invisible' account have upon our foreign trade? How many people have realized that there is a relationship between the two classes of payments, or that they have influence upon each other? And yet a moment's reflection will show that the payments and receipts of a country in international relations must balance in the aggregate.

"In the past it was necessary for the United States to have a trade balance of approximately $500,000,000 per year in order to pay the charges accruing against it abroad: but in the future it will be necessary for the United States to receive a balance of perhaps an equal amount in order to collect the interest running in its favor and against other countries.

"This may sound to some people like a startling and even alarming change. Our own history has accustomed us to thinking that we must have a trade balance in our favor in order to be in a sound and prosperous condition, but that was true because we were in a debtor position. We had to have an excess of exports over imports sufficient to meet the other charges in the account against us.

"We must now consider that our position is reversed, that our own requirements are reversed, and that the countries which are now debtor to us need to have the favorable trade balance for the same reason that we formerly required it. It is in the interest of both sides that the debtor country shall have the favorable trade balance, because that is the only condition under which it can meet its obligations.

"The plain truth is that if in our relations with the rest of the world the balance of payments runs continually in our favor, both on trade account and on interest account, exchange rates will rise against us as the balances increase, discouraging exports and encouraging imports, until the trade is brought substantially into balance."



Producing 17,000 Connecting Rods a Day—I

By FRED H. COLVIN
Editor, *American Machinist*

The methods used by the Ford Motor Co. which are here described differ from the usual practice in two particulars. The first is that instead of machining the ends of the bosses as working points, the work is located from the piston-pin hole, the ends being faced square with the holes and the length of the boss gaged in a very simple manner. The second departure is in forging and machining the rod and cap separately up to the final boring, facing and broaching operation. Both the methods and the results are extremely interesting.

ONE of the striking features of the connecting-rod department of the Ford Motor Co. is the conveying system which brings the forgings from the straightening stand shown in Fig. 3 to the drilling machines across the main aisle, as shown in the headpiece. The arch over the aisle is for clearance in any kind of trucking which may be necessary, and not for the purpose of making an imposing display. This conveyor carries hangers at short intervals, each hanger accommodating three connecting rods as shown. The conveyor moves continuously and is loaded at the straightening bench so that the men at the drilling machine shown are always supplied with work. It is only necessary to reach up and pick a rod out of the rack which happens to be most convenient, the operators rarely looking up but depending almost entirely upon the sense of location and feeling to pick out a rod forging whenever it is needed.

An outline of the various operations is shown in the transformation sheet, Fig. 1. Of the 17,000 rods required per day, about one-third come from the Ford forge shop. After trimming and snagging inside and out, the rods are heat-treated before going to the machine department. This consists of a heating, quenching and an annealing, after which they are again struck in the dies to straighten them and condense the metal. Then comes the tumbling in the large tumbler shown in Fig. 2, cleaning with a sand-blast, and then the straightening, as shown in Fig. 3. The simple pedestal shown, placed at the height of a man's eyes, enables him to inspect the straightness of the rods very rapidly, and any straightening which may be necessary is done on the block shown at *A*. These blocks give the same sort of a flat surface as an anvil, and also have an opening at the end which will hold the end of the rod in case any twisting is necessary. The inspectors keep the racks of the conveyor practically full and the rods go on their way to the various machining operations.

It will be noted that the small end of the rod has a very decided center punched in by the forging die. This is used for centering the roughing drill, no bushing being used in this operation, as can be seen in Fig. 4. The rods are very quickly handled by means of the clamping wheel *A*, the main requirement being to hold the rod square on its face and prevent it turning under the action of the drill.

The sides of the piston-pin boss are then spot-faced by a facing tool with a pilot, the length of the pilot in connection with the stop pin which locates the piston-pin hole determining the length of the piston-pin boss. The way in which this operates will be shown in a later illustration. Next comes the rough-reaming, which is

AUTOMOTIVE CONSTRUCTION

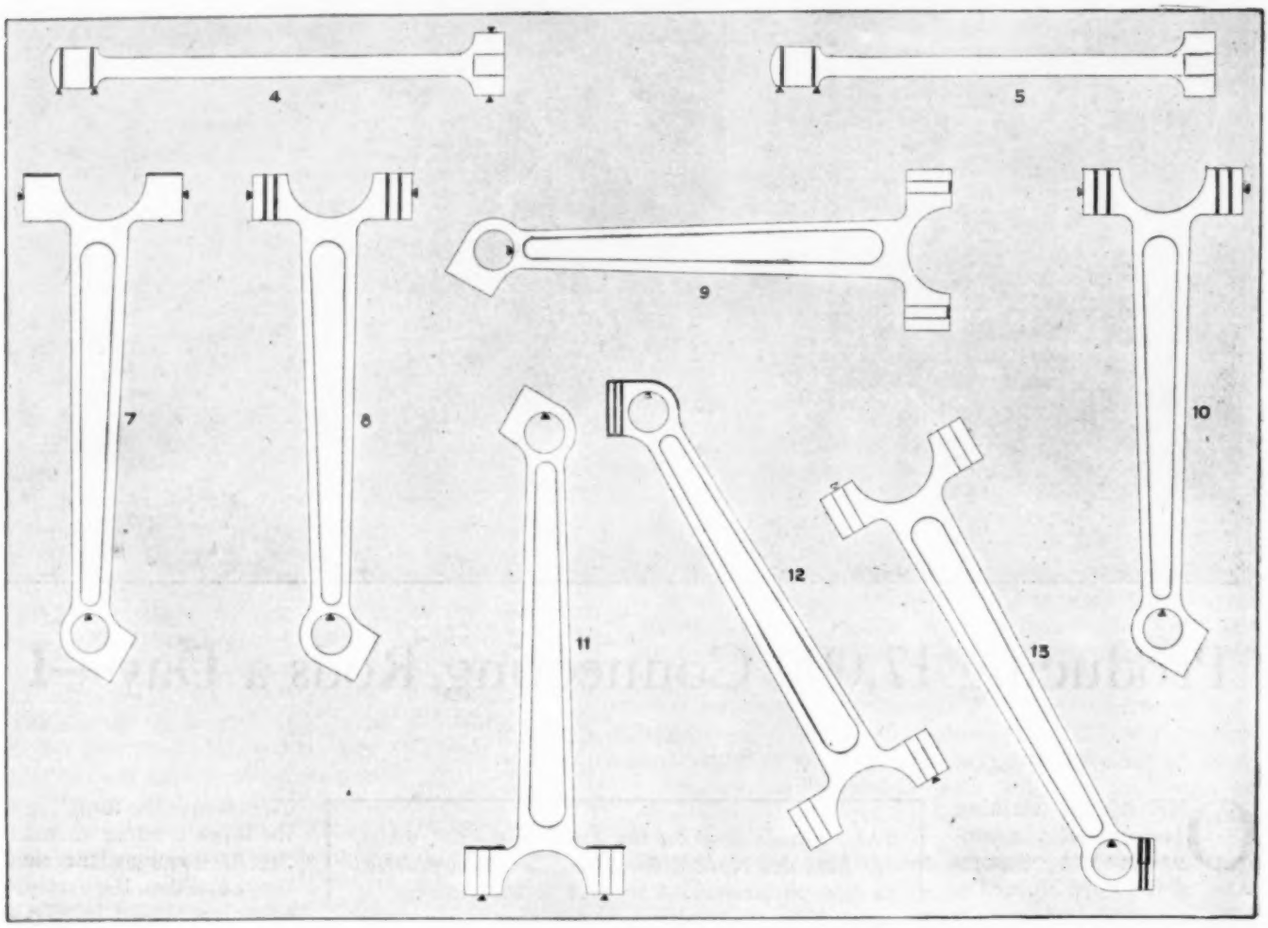


FIG. 1. TRANSFORMATION OF OPERATIONS ON FORD PISTONS

a simple operation, as in Fig. 5. The fixture is of the simplest kind, the rod being located under the plate *A* and against the pin *B*. The pin *C* is simply a stop which prevents the rod from turning under the action of the reamer. Flooded lubrication is used throughout.

The rods are now rough-straightened from the reamed piston-pin hole, as shown in Fig. 6; an easily handled pin *A* goes through the piston-pin hole, the small end

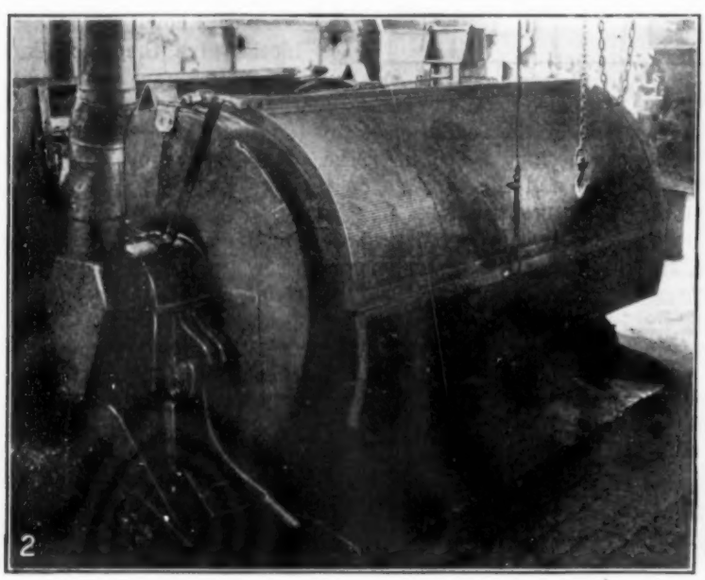


FIG. 2. TUMBLING BARREL FOR FORGINGS

FIG. 3. FIRST INSPECTION AND STRAIGHTENING

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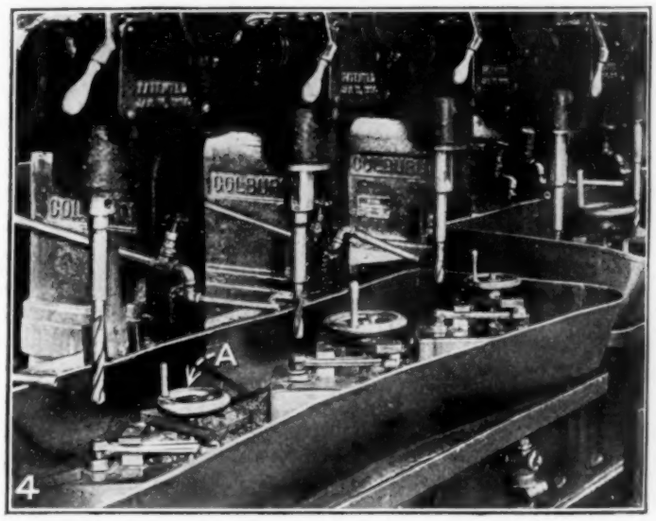


FIG. 4. ROUGH-DRILLING PISTON-PIN HOLE

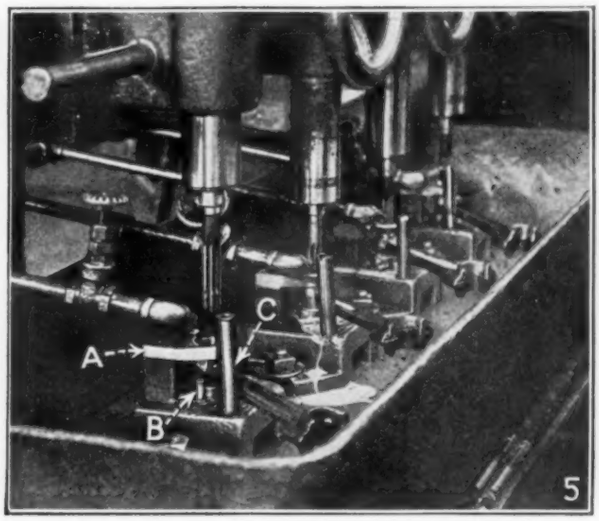


FIG. 5. ROUGH-REAMING PISTON-PIN HOLE

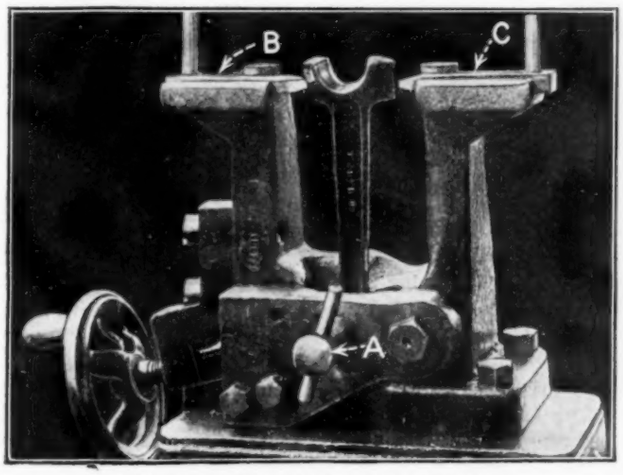


FIG. 6. THE SECOND INSPECTION

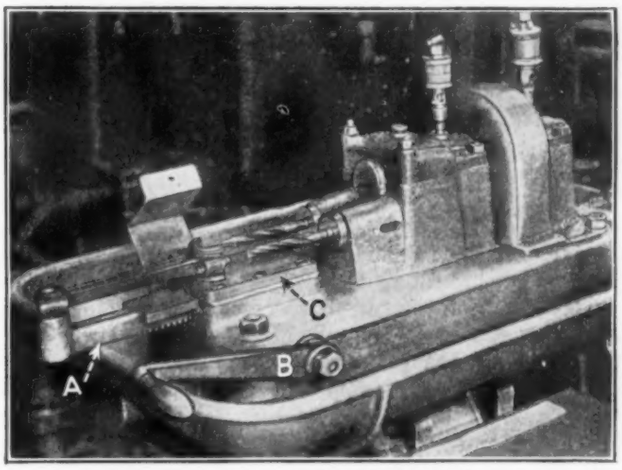


FIG. 9. BURRING BOLT HOLES

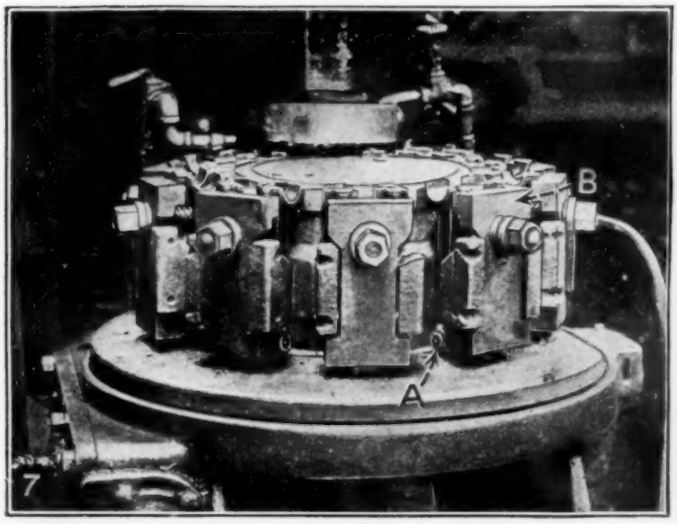


FIG. 7. MILLING LARGE END OF ROD

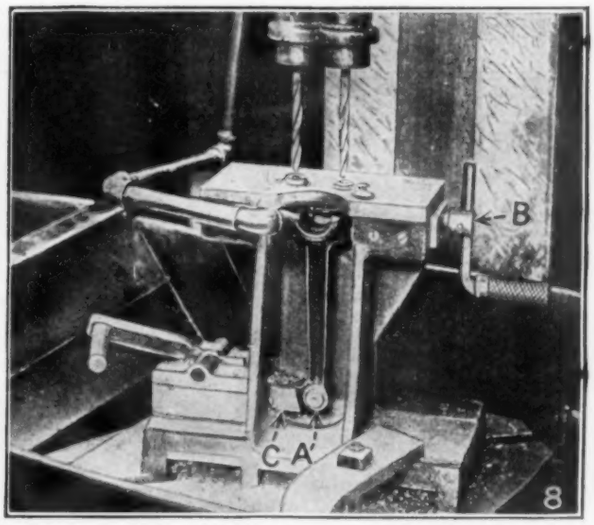


FIG. 8. DRILLING BOLT HOLES

then being clamped by means of the handwheel shown. The sliding gages *B* and *C* show whether the rod is twisted or not, and how much. Gage *B* has a forked end, while *C* is a single point. These gages test the rods by the bolt bosses and can be handled very rapidly.

Using the piston-pin hole as the locating point, as at

AUTOMOTIVE CONSTRUCTION

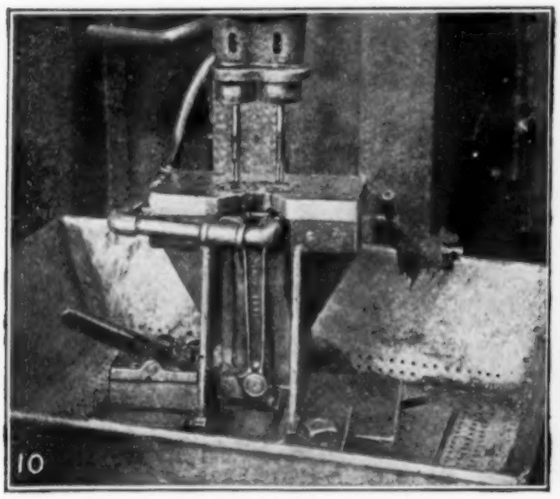


FIG. 10. REAMING BOLT HOLES

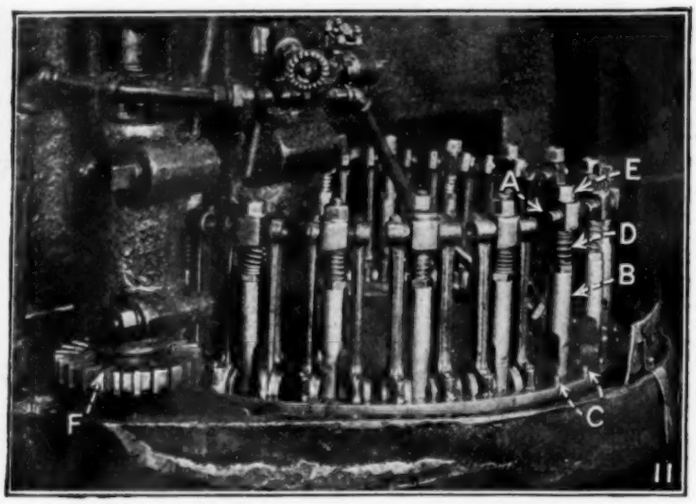


FIG. 11. MILLING END OF BOLT BOSSES

A, the rods are placed in the double fixtures shown in Fig. 7, and the faces of the large ends surfaced in the continuous milling machine shown. The single clamping plate *B* enables the rod to be very easily handled. The fixture holds 20 rods and handles 250 per hour. Cutters are changed two or three times per 8-hour shift, the change averaging 15 minutes.

DRILLING THE BOLT HOLES

Next comes the drilling and burring of the two bolt holes, the fixtures being shown in Figs. 8 and 9. The rod is located on the pin *A*, the screw clamp *B* holding the upper end, while the clamp *O* holds the lower end firmly against the pin. The drilling time is about 40 sec. The burring is done on a special motor-driven two-spindle machine shown in Fig. 9. The rack *A* carries a pin on the outer end which fits the piston-pin hole, and the crank *B* operates the pinion which forces the rod over the burring drill shown. The large end of the rod simply slides on the steel plate *C*. These machines handle 1,200 rods per hour.

The reaming of the bolt holes, Fig. 10, is identical with the drilling in Fig. 8. Lubrication is freely used, as can be seen from the large splash pan which has been provided. The seat for the bolt head is another continuous-operation job and is shown in Fig. 11. This is a somewhat different type of fixture, the pins *A* which fit the piston-pin hole being carried in a crosshead on the upper end of the pillars *B*. The lower end of the rod is located by the dowels *C*, which fit the bolt holes.

The crossheads carrying the upper pins are normally raised by the springs *D*, so that when the connecting rod is slipped over the pin *A* the lower end clears the dowel pin beneath. The nut *E* is then tightened and forces down the crosshead, carrying the two rods, and holds them firmly in place while the upper ends of the bolt bosses are being milled by two cutters, the outer one being shown at *F*, while the inner cutter is hidden by the fixtures.

Another simple but interesting fixture is shown in Fig. 12, this being for drilling the clamping-screw hole through the piston-pin boss. The rods are located by

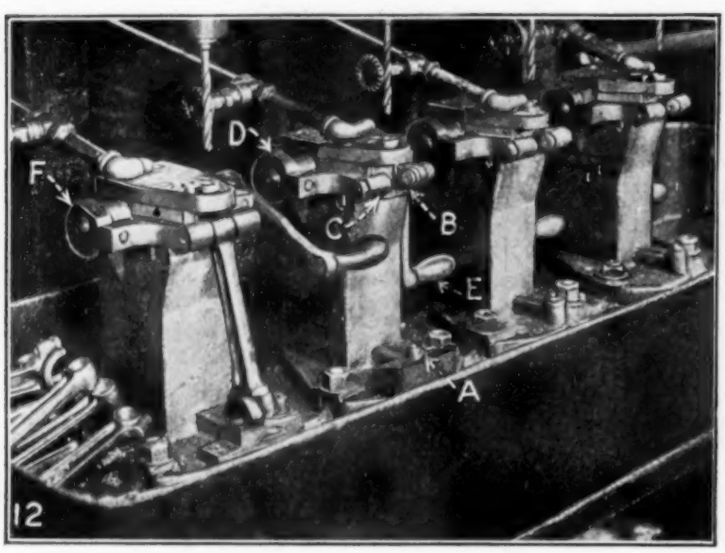


FIG. 12. DRILLING FOR CLAMPING BOLT

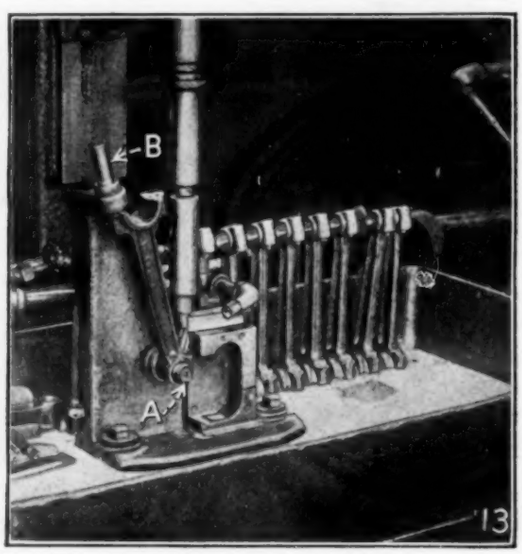


FIG. 13. DRILLING BODY HOLE

AUTOMOTIVE CONSTRUCTION

the dowel pin *A* in one of the lower bolt holes, while the piston-pin hole fits over the fixed stud *B*. Then the movable stud *C*, which is controlled by the cam *D*, is swung into contact with the other side of the rod by the handle *E*, holding the rod firmly during the drilling operation. The position of the cam when the arm is closed can be seen at *F*, and this picture also shows the handle in its raised position. Some idea of the ease with which the fixtures can be handled may be had from the fact that the four spindles drill about 200 holes per hour.

The larger or clearance hole for the binding bolt is drilled in the fixture shown in Fig. 13. Here, of course, it is necessary to reverse the position of the connecting-rod, but the same locating points are still retained. The rod is simply slipped over the pin *A* and the locating pin *B* slid into the left-hand bolt hole, making this a very easily handled operation.

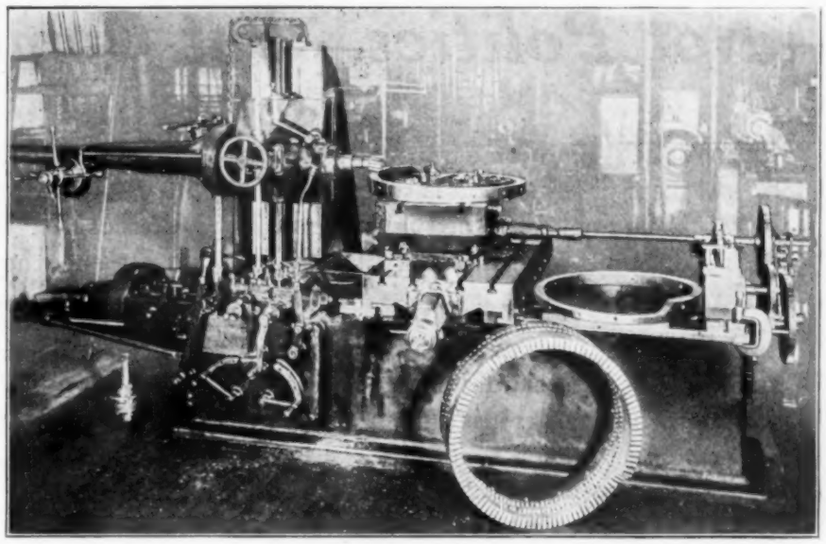


FIG. 1. BORING MACHINE CUTTING LARGE CAMS

Cutting Cams on a Boring Machine

BY FRANK C. HUDSON

The adaptability of an accurate horizontal boring machine when in the hands of skilled mechanics is illustrated in Figs. 1 and 2, which come from the toolroom of the Ford Motor Co., Detroit, Mich. A general view of the machine, which is a Lucas, is shown in Fig. 1.

The outer support has been removed from the end of the bed, and in its place is a housing, *A*, Fig. 2, held in position by two C-clamps. This support carries the gearing shown, which is driven from the head of the machine in the same way that the outer bearing is moved in the support which has been removed from the bed.

This gearing drives the rotary table *B* by means of shaft *C* and the gearing is so proportioned as to turn the cam being cut in the correct relation to the milling cutter which is raised at the proper rate by the elevating screw of the regular spindle head.

The method of cutting the blanks for the cams can be seen from the cylinder standing in front of the boring machine. This is turned and bored to the proper dimensions and is then cut up by drilling a series of holes so that one line makes a straight cut, while the next row of holes gives a very close approximation to the contour of the finished cam. The screw holes for fastening the cam in position on the machine are also drilled at the same time, so that the cam is completed, except for a few finishing touches, when it comes off the rotary table of the machine.

While this is an unusual method of cutting cams for automatic machines, it has been found satisfactory, and reflects credit on the ingenuity of those who devised it.

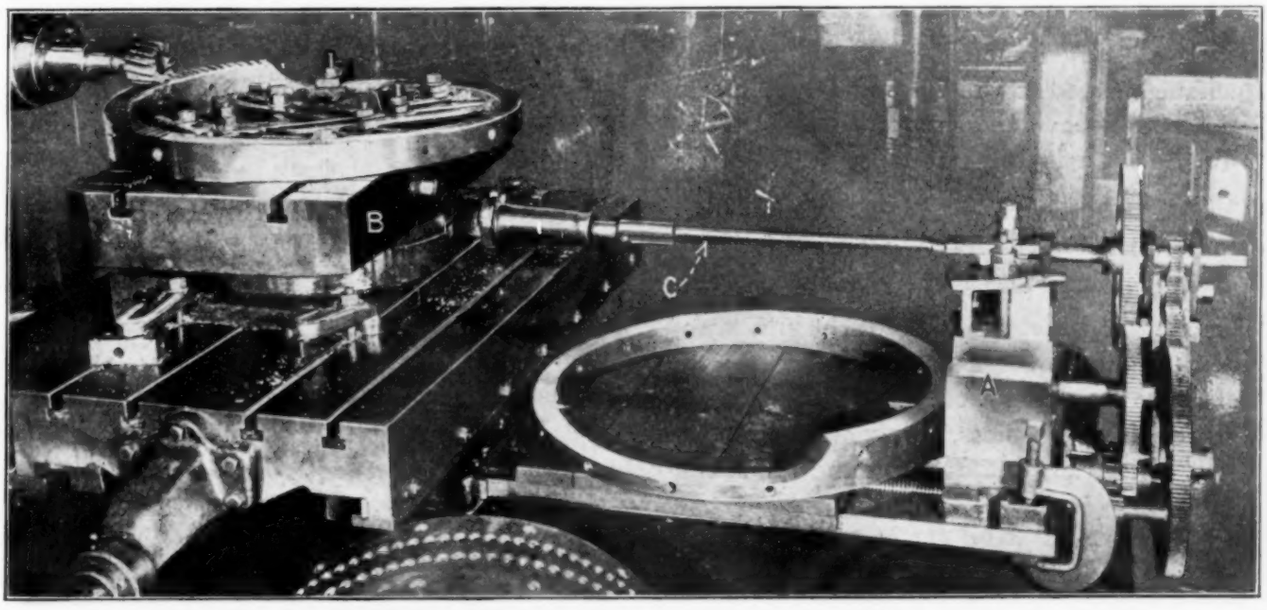


FIG. 2. DETAILS OF THE SET-UP AND GEARING

Not Politics—but Common Sense

EVERY time some unusually foolish piece of legislation is threatened, it is jarringly bumped into the business men that they have practically no real representation in legislative bodies.

Politicians of the professional type as a rule, pick the candidates and select mediocre lawyers, business failures, second-rate newspaper men and others of this class, mainly with an eye to their amenability to suggestion and their "stand-in" with certain organizations.

The real business man and manufacturer is too busy—or thinks he is—to bother with politics and votes mechanically for what he thinks to be the least of the evils put on the slate.

He has no standing or influence with the politicians, such as an organized body has, and consequently seldom sways a nomination.

Generally speaking, the average business man does not understand the issues. If he gives to the campaign fund, and votes—if the weather is nice,—he feels that he has done his share.

If a business man of ability is, by any chance, asked to run for office, he almost invariably says he cannot afford the time or the financial sacrifices.

All this is wrong. He CAN afford it, and in the final analysis he DOES.

Every year he has to spend time and money lavishly to head off injurious laws and regulations. Sometimes—often—he fails to head them off and pays heavily, through his business, for worse than foolish legislation put over by the schemers and the ignorant.

Things will **never go right** in this country until we put men into office who are **successful business men in a large way**—be they manufacturers, engineers or merchants.

The first question asked regarding a candidate for **ANY** office, should be: "Is he a **success** in his line and does he understand the needs of industry **FROM THE INSIDE?"**

We need a new order of "minute men" who will drop everything at the call, and go to the primaries and the polls for the good of industry which is also the country's good.

We need industrial giants in office to take the place of the meddling pygmies that are now so common.

We need *successful* engineers in office. Those who are used to gathering facts and coolly analyzing them in their relation to industry before deciding on a course of action.

If men of this type are sent to legislatures, to Congress, and are put into high office, we won't have to be continually on the alert for the appearance of foolish, dangerous, industry-crushing legislation.

We need another Paul Revere, **BUT DON'T WAIT FOR HIM.**

THIS ISN'T POLITICS—IT IS COMMON SENSE.

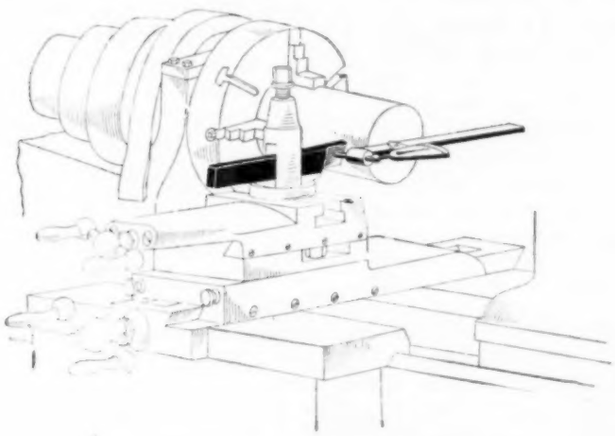
Ethan Viall

Editor

Gages for Setting Tool for Cutting Off Piston Rings

By Roy F. Leighton

In the illustration may be seen a gage for setting the parting tool for cutting off piston rings from a pot casting. The sliding pin that bears against the gaging point of the indicator is easily removable and pins of different lengths should be made to accommodate different thicknesses of rings.



DEVICE FOR SETTING PARTING TOOL

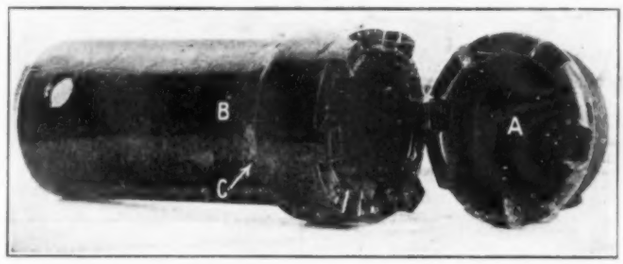
Using this device for setting the parting tool I have cut off twelve rings with an accumulated error of but 0.004 in.

A Home-Made Valve-Cap Wrench

By Bill Hughes

In repairing or overhauling automobile engines it is necessary to remove several caps having castellated tops as shown at *A* in the illustration. A spanner wrench for this purpose is generally supplied by the maker of the engine, and works well while the engine is new, but after considerable carbon has formed the strain necessary to remove the caps will soon batter up the castellations and sometimes break them off.

To overcome this difficulty, I made the wrench *B*, of steel pipe. A coupling was screwed on the pipe to increase the thickness and welded at *C*. The end of the coupling was then faced off and castellated to match the plugs. Holes for a bar drilled in the upper end of the pipe completed the job.



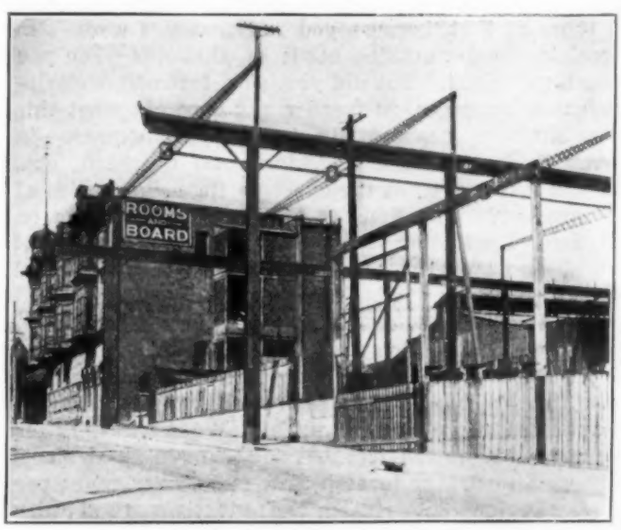
A HOME-MADE VALVE-CAP WRENCH

Pipe was used for the wrench both for lightness and to go over spark plugs, pet cocks, etc., that protrude from the plugs.

A Good Layout for a Yard Crane

By C. W. Geiger

At the Baker Iron Works in Los Angeles, Cal., the tracks of the traveling electric yard crane have been extended over the street that passes the plant, thus enabling heavy pieces of machinery to be loaded or unloaded from trucks without the necessity of driving into the yard. As shown by the illustration, steel poles, riveted to the tops of the columns supporting the tracks, carry the telephone wires. This eliminates the danger of these wires coming in contact with the feed wire that supplies the crane motors.



TRACKS OF A YARD CRANE EXTENDING OVER THE STREET TO FACILITATE LOADING

WHAT to READ —for the man in a hurry

Suggested by the Managing Editor

WE lead off this week with another manufacturing story. It comes from our Western Editor, J. V. Hunter, and deals with the production of Household Appliances in one of the modern plants in the Middle West. There is good evidence given that industry is doing its share to counteract the effects of labor shortage in the home.

For those engaged in work which requires machining aluminum, P. T. Lennon's contribution, "Machining Aluminum Pistons," beginning on page 1175, will touch the spot. The author gives freely of his knowledge gained by experience, and hopes, as we do, that his treatise may elicit an exchange of ideas and suggestions from you.

Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.

As a machinist, many a time you have watched your chance of making "premium" go by while you chased up a drill, or a reamer, or a tap, haven't you? And you've cussed the system, or lack of system, which forced you to be a pretty fair detective to find the tool you needed. And when you finally found it, how was it ground, or what condition was it in? You growled and let it go at that, because you felt that you weren't in a position to do anything about it—that was when you were a machinist. But did you, as a foreman, superintendent or manager, go further and dope out what this same situation meant in the way of plant expense—in direct production time lost, increased overhead, etc., and did you figure out the effect on the selling price of the product? The fifth of W. R. Basset's series on "Modern Production Methods," dealing with "Tool Issue," on page 1177, shows the evils of a lack of good system in handling tools from a centralized station, and details a system devised for economy and efficiency.

We don't hesitate to step into an automobile and "step on it" for from thirty to sixty miles an hour; at the same time we realize that we are relying upon a rather complicated mechanism not to fail. We are waiting for the day when we can feel just as secure in an airplane, only we'll not want to stop at a mere sixty miles per hour. Designers, engineers and scientists are at work to bring this condition about, just at they worked for years on the automobile. Not the least important factor in such development is the art of heat-treating metals. "Heat-treating of Brazed Fittings for Aircraft," by Archibald Black, page 1184, is a compilation of data which has been issued by the Government and steel concerns from time to time, and a summarizing of its facts. "Brain vs. Brawn" by John A. Honegger, page 1186, is an article which will interest the designer and engineer. It treats of something with which they are very familiar and in the author they have a champion of their cause.

We see both humor and pathos in a condition which offered Watt cylinders for his steam engine, bored with a variation in diameter of as much as one-half inch. Suppose Watt had not been able to get a cylinder bored with sufficient accuracy to prove his theory! Increased accuracy in machine tools is the subject of this week's installment of H. H. Manchester's series on "The Evolution of the Workshop"—page 1187.

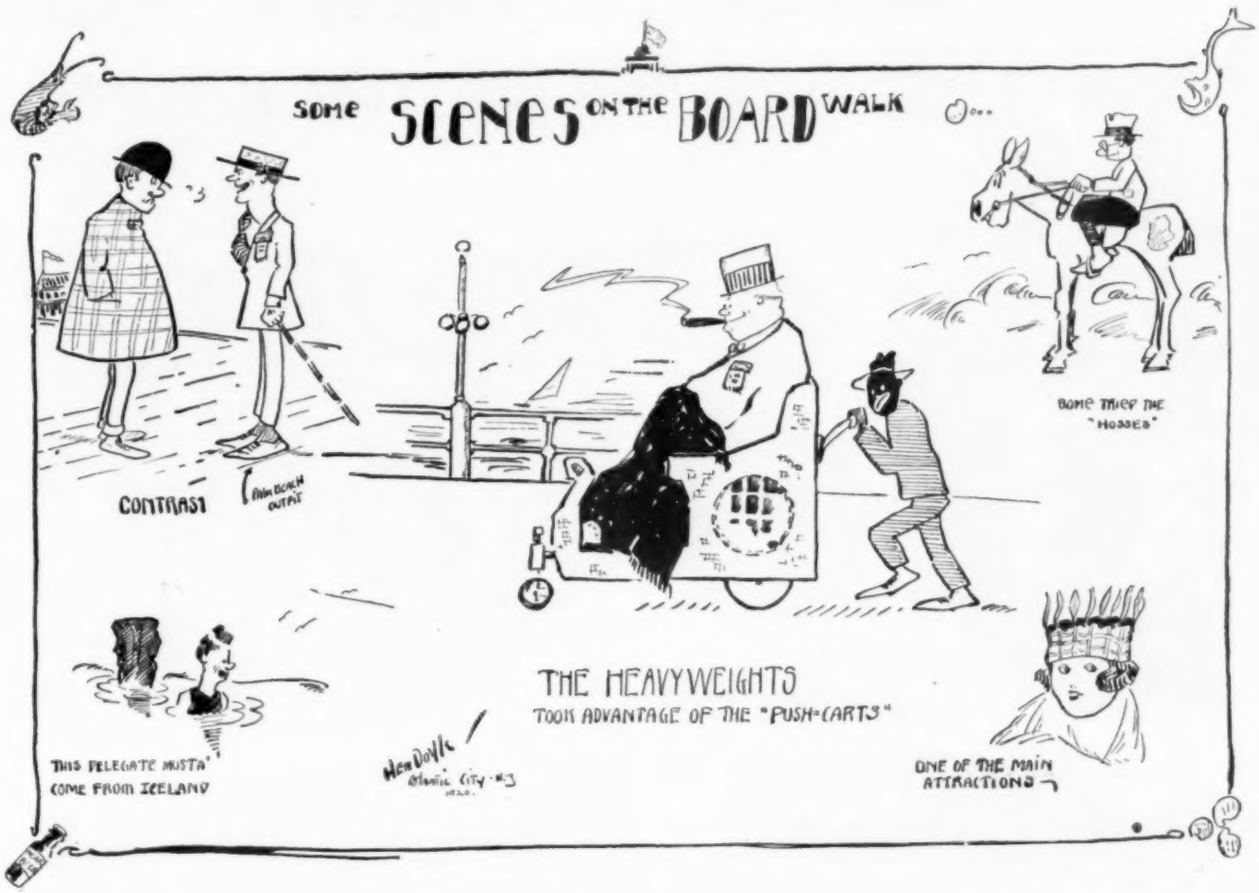
"Load Characteristics of Radio-Thrust Bearings," page 1190, by F. C. Goldsmith is directed particularly at F. W. Gurney, whose treatise on the same subject we published in Volume 50. There is no reason why you shouldn't get in on it, if you want to. It offers a very nice little task, if you follow through the "math" and "trig." Answer the closing question if you can.

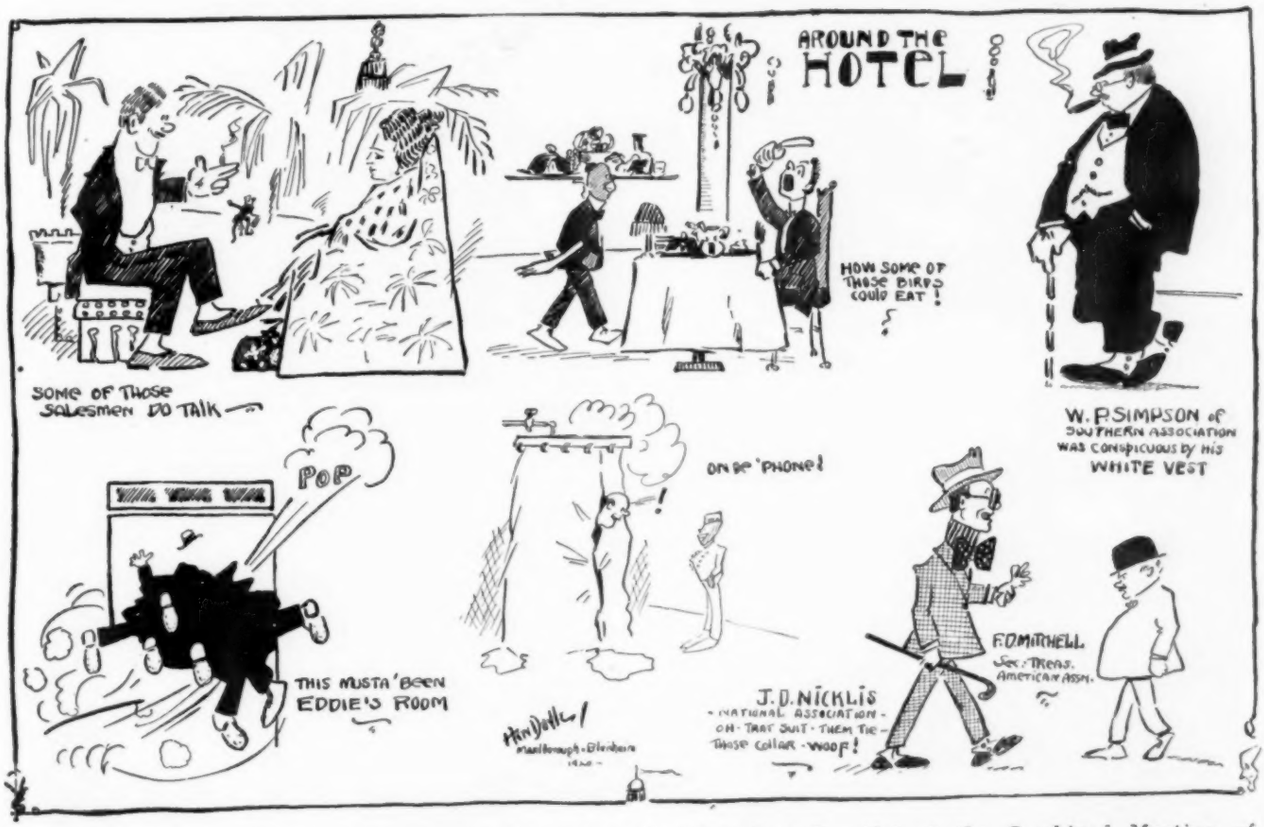
You will find Fred Colvin's article, page 1199, up to the very high standard of his Automotive Series. This week it is on "Producing 17,000 Connecting Rods a Day." Yes, it's Ford's plant. Part II will appear in the issue of June 17.

Doyle's cartoons on the "Machinery" conventions at Atlantic City speak for themselves—page 1207.

Beginning on page 1210 we give a resumé which touches the high spots of the National Foreign Trade Convention at San Francisco. There is a digest of the addresses to come next week. Foreign trade is becoming a larger and larger factor in American business; it will pay to learn all you can about it.

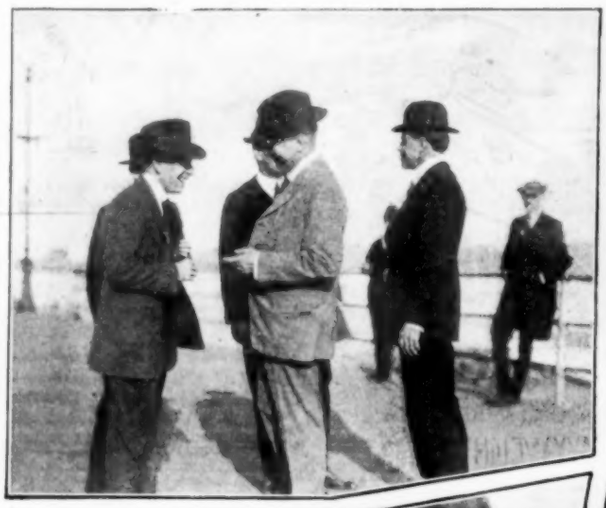
The first part of William H. Barr's address on "Labor and Industry" appears on page 1212; the second part will appear in our next issue.

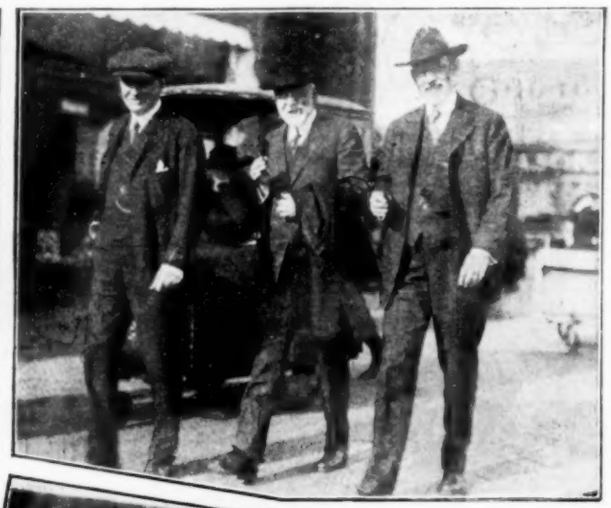

SOME SCENES ON THE BOARD WALK
CONTRAST
SOME THEY THE "HOSSES"
THE HEAVYWEIGHTS
TOOK ADVANTAGE OF THE "PUSH-CARTS"
THIS PELEGATE MUSTA' COME FROM ICELAND
ONE OF THE MAIN ATTRACTIONS

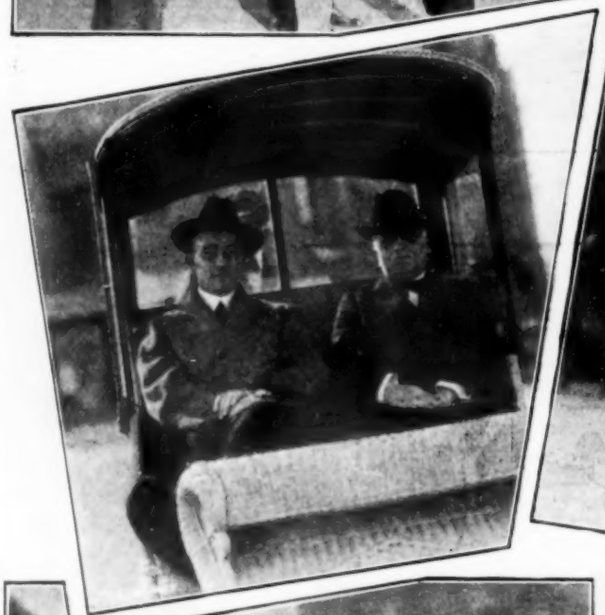

AROUND THE HOTEL
HOW SOME OF THOSE BIRDS COULD EAT!
SOME OF THOSE SALESMEN DO TALK
W. P. SIMPSON of SOUTHERN ASSOCIATION WAS CONSPICUOUS BY HIS WHITE VEST
POP
ON DE 'PHONE!
THIS MUSTA' BEEN EDDIE'S ROOM
J. D. NICKLIS
- NATIONAL ASSOCIATION -
OH - THAT SUIT - THEM TIE - THOSE COLLAR - WOOF!
F. O. MITCHELL
Sec.-Treas. American Assn.

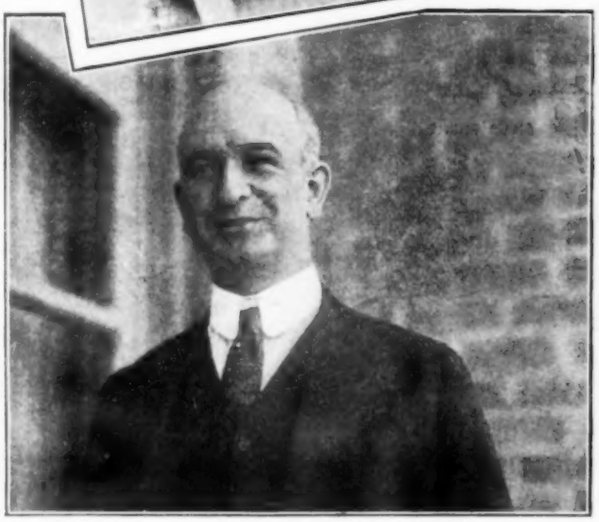
Sidelights of the convention as seen by the "American Machinist" staff artist at the Combined Meeting of Machinery Dealers and Manufacturers at Atlantic City.

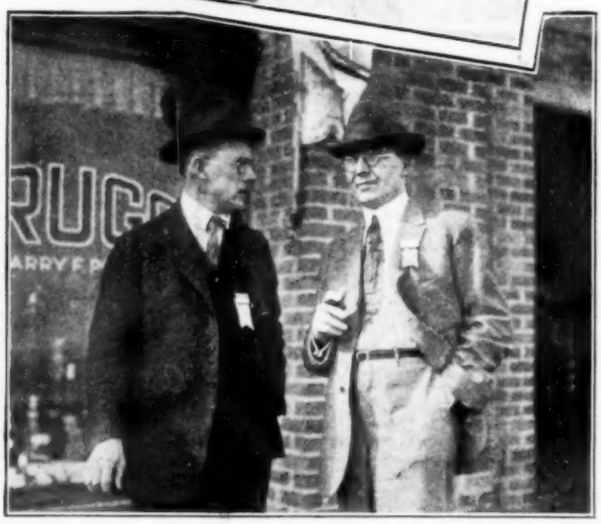
Recess Periods at Machine Tool Builders' Convention











W. MARSHALL TURNER
President, Southern Supply and Dealers Association

COL. CRANNELL MORGAN
President, National Supply and Dealers Association

CHARLES D. BEAVER
President, American Supply and Machinery Association

Here we have the pictures of the newly elected presidents of the three associations. Each is a "captain of industry"—a leader in his particular field. Crannel Morgan is president of the Hardware and Supply Co., of Akron, Ohio, and is well-known to the machinery trade. Marshall Turner, president of the Turner Supply Co., of Mobile, Ala., is one of the most prominent machinery dealers in the South. Charles D. Beaver, foreign sales manager of the Yale & Towne Manufacturing Co., New York, by reason of his long business experience and intimate acquaintance with foreign and domestic trade, is one of the best informed men on present world industrial conditions.

With leaders of this type, the Dealers and Manufacturers associations should enjoy a prosperous and progressive year.

Predicts Renewed Business Activities

The following is an extract from the address delivered by J. D. Nicklis, president of the National Supply and Machinery Dealers' Association, at the opening of the annual convention of that body at Atlantic City, N. J., May 17, 1920. Mr. Nicklis is prominent in the machinery trade and his opinions on commercial conditions of today are worthy of note. Mr. Nicklis is manager of the supplies department of the Manning, Maxwell & Moore Co., New York.

"When we assembled a year ago in Pittsburgh the opinion prevailed that we had reached the peak of high prices and that the industrial life of the country was facing one of the most critical periods in its history. Events have proved that we were at that time entering a period of great business activity, which for the most part has continued and is in force at the present time. Most of us can recall listing our overstock, whereas today we are worrying a great deal about our shortage. The floors and shelves of our factories and warehouses have been swept clean and there is evidence on every side of a large accumulation of unfilled orders many months in arrears. Even with the price of labor and material at its present height, and with the end apparently not yet in sight, it is difficult to believe that the wheels of commerce are going to slow down in the near future.

Refuse to Consider Lower Prices

"The Mill and Factory representatives with whom you come in contact, refuse to consider the idea of lower prices this year and are urging your buyers to get goods wherever obtainable to keep up stocks. The leading industries report great activity and are well booked with orders. Manufacturing as a rule shows undiminished activity. Production in certain lines has been speeded up to meet the demand but in most cases there is a great under-supply of special productions and this applies to many items handled by the members of this association.

"The greatest obstacle to trade during the past month, outside of the serious shortage in many lines, was the inadequacy of transportation facilities and the almost complete tie-up brought about by the "outlaw" railroad strike. The effects of this strike will in all probability be felt for months to come and let us hope that the strike will be settled before factories for want of fuel and other raw material are crippled any further. It is certainly to the interest of the country at large that the normal routine of production of business keep on with as little interruption as possible.

Country Prosperous for Past Five Years

"It is not difficult to look back and find that the country has been very prosperous for the past five years. Everyone has been making money, employers and workers alike. Wages have gone up and at their present level are way beyond the wildest dream of labor leaders in 1914. Yet the irritating fact remains that for most of us, the extra wages and profits are balanced by the ever-increasing expenses.

"The future of this association is very bright and to say that we have earned an enviable place among organizations of this character and are firmly entrenched in the esteem of the trade would be putting it very mildly indeed. Having earned that position it would be dangerous for us to rest on our laurels. With this growth in membership and influences, I hope this convention will suggest new fields of endeavor in order that the organization may maintain the present strong position and continue to grow."

Seventh National Foreign Trade Convention

THE Seventh National Foreign Trade Convention was held in San Franciso, May 12-15, 1920, most of the sessions being in the new Auditorium which is a part of the new Civic Center, a monument to the foresight of some of those who are responsible for the re-building of the city. All previous records of attendance were smashed to smithereens, about 2,500 delegates registering. The weather was fickle to the extent of being disappointingly cool to both natives and visitors, the latter naturally expecting balmy days to match the wonderful flowers and shrubbery. The sun was kind however and the hospitality displayed to both delegates and ladies had sufficient warmth to make up for any deficiencies in the outside temperature.

The delegates came from all over the world, the far east being especially well represented. All were apparently anxious to do business with the United States. Ocean transportation is a huge factor in this trade, the Philippinos pointing out the great hardship of irregular and inadequate steamer accommodation to their ports. This was also touched on by Robert Dollar in his address of welcome, in which, quite incidentally, he gave voice to his opinion that the center of the world's trade must inevitably line on the Pacific Ocean.

Imports as Well as Exports

Mr. Dollar pointed out the problems of ocean transport, showing the necessity of full cargoes both ways in order to secure minimum freight rates, and that at the present time we are shipping long, straight, staple cotton to China and bringing back short fiber, curly, Chinese cotton, which afterward becomes "wool" through some of the modern methods of transmutation. However, a side light on the question of ballast comes out in connection with the manufacture of glass and glassware on the Pacific Coast, for much of the sand used comes from Belgium in ballast, and being ballast, the glass companies can secure it at a low rate. Just how full cargoes each way would affect them it is not difficult to figure out.

Machine Opportunities in China

An urgent need of the country, as brought out by conversations with those fresh from the great land of China, is the repeal of the laws which make it impossible for for the young men of that country to come to the United States to learn our methods and our machines by actually working in our shops. China naturally turns to her best friend of the days of the Boxer Rebellion, to learn modern methods and to buy modern machinery. But she is confronted with the law which compels, or at least allows, consuls to refuse passports to young Chinese men who want to come here and work in our shops to learn our machinery and the methods of handling it. Passports may be granted if the man agrees to work without compensation all the time he is here, and can be, and are being, refused if the consul professes to believe that the young man may accept wages after he arrives.

This is resulting in many young Chinese men going to France, which is welcoming them without any such foolish restrictions and naturally means that they will become familiar with French machines and will buy French machines when it comes to equipping their own, or other Chinese shops. All of which may result in diverting a large amount of business from this country to France and England, business which the Chinese would for various reasons, prefer to place in this country.

Double Taxation

Another difficulty in the way of foreign trade is the present law by which American organizations for such trade are taxed both at home and abroad and so placed at a disadvantage, as traders from other countries have no such handicap. A large representation of American business men from China are making strenuous efforts to have this handicap removed, but with a Congress more interested in mending and strengthening fences than in matters of national welfare, it is doubtful if anything can be done at present. And the longer this is delayed the greater hold will other countries secure on the business in foreign countries.

One need only glance at the list of papers presented to the convention to see that practically every phase of the situation was considered and discussed. Many of these deal with the financial problems involved, the questions of exchange, the methods of determining which fields to enter, and direct selling, being parts of that feature of the program.

The general feeling, as James A. Farrell expressed it, was that "The United States must become a foreign trading nation—its industrial development has reached just that stage," or as R. M. Calkins said, "As the growth of our commerce exceeds the demands of the domestic market, the surplus can be only disposed of in the markets of the world."

Beginning in Our High Schools

One of the striking papers presented was by E. L. Bogart, of the University of Illinois, on "How and Why Economics Should Be Taught in the High Schools." The "why" is because comparatively few go beyond high school and if they are to be groomed in the fundamentals of economics it is necessary to do this while they are available. The necessity for it is pointed out in the author's endeavor to clear away misconception as to how economics affect the every-day life—and death. Mr. Bogart rather shatters some of our ideals, but economic law seems to recognize no sentiment. The paper starts off with

"The most important questions which confront our civilization today are economic in character, and even those which have to do with other activities or interests are affected by economic considerations. An excellent illustration of this fact is found in the issues which are being discussed in the present presidential campaign —immigration, foreign trade, federal taxation industrial relations, high cost of living, etc.

"Without taking the extreme view of economic determinism, it may safely be asserted that our leading problems are economic and that their correct determination calls for a knowledge of economic science and the application of correct economic principles. The Great War and its effects provide the world with its great outstanding problems today. Not only are these primarily economic and financial, but the war itself in large measure grew out of economic considerations.

"The economic pressure of a rapidly growing popula-

tion in Germany, which doubled in sixty years, combined with an incorrect analysis of the nature and value of foreign trade, together with overweening political and military ambitions, led to the greatest war in history. Our own participation in this struggle was made necessary by the disregard and defiance of our rights as neutral traders. In fact it can be shown that the determining factor in all wars in which this nation has engaged, has in the last analysis been economic in its nature. The colonists went to war with England in defence of their right to carry on profitable lines of trade which the mother country tried to suppress, and also of the right to issue their own paper money. "Taxation without representation" made a convenient slogan at the time, but it is now recognized that more fundamental economic issues lay behind the political demands. The war of 1812 was fought to secure our commercial rights on the high seas; the war with Mexico resulted from the need of the slave-owners of the Southwest for more land in which to push their extensive exploitative system of cotton growing; the Civil War was at bottom the inevitable struggle between two opposing systems of labor, that of the free labor working for a competitive wage and that of compulsory slave labor. Even the Spanish War, in which idealistic motives probably played as large a part as is possible in any such struggle, may be traced to the investments in Cuban sugar plantations of American capital. And if we should go to war with Mexico in the future, does any one doubt that our investments in oil lands would be a leading factor in bringing about such a conflict? The justification of a resort to arms to decide the various issues involved in these wars need not be raised; the simple fact remains that the issues themselves were fundamentally economic.

Economic Questions Most Important Now

"There never was an age in which economic questions were so important or so predominant. Human interests differ from time to time and so too the problems vary which are presented to society for solution. In the Middle Ages men's minds were absorbed by religious considerations, and from the theological controversies there resulted the Reformation. In the seventeenth and eighteenth centuries the great issue presented was that of constitutional government and to its solution the greatest intellects of the day gave their best. But the nineteenth century was primarily industrial; in that period industry was completely revolutionized and greater progress was made than in all preceding history.

"The rapid, almost dizzy, progress of this period has left to the twentieth century some serious economic problems, whose solution calls for the application of our best talents. We are often reproached for the sordidness of our interests and all called material-minded; but the truth is that no greater challenge was ever given to the human intellect and soul than is presented by the social and economic problems of today. The present industrial unrest has moreover rendered these problems much more significant and their correct solution more imperative than has even been the case before."

Must Exchange Products

All through the convention one could not escape the trend of thought and argument that foreign trade must mean buying as well as selling. The old notion that we must make all that we need and then sell the surplus to foreign countries, has no foundation in economic theory or practice. For after all, trade is only bartering or exchanging products as it has always been and must be. The only difference is that modern business methods with credits and easy methods of exchange, make it unnecessary for the producer to barter direct with the consumer. The emphasis laid on imports as well as exports should help to assure other countries that the advantages of trading with the United States are not all one sided.

The Foreign Trade and the Press

One session was devoted to the part the trade and technical press has played and will play in stimulating foreign trade. The three papers were: "The Service of the Business Press," by James H. McGraw;* "The Agricultural Press," by G. Howard Davidson, and "The Export Press," by Franklin Johnston. Each brought out salient points in the matter of securing and holding foreign trade and the way in which proper publicity, through thoroughly established mediums, can be of great assistance.

It was pointed out that as the conditions in any country reflected and reacted on all the rest, it was essential that we appreciate the necessity of aiding prosperity in all other countries as well as our own; that fair and comfortable living conditions for all people were the best and only answer to ultra-radical ideas and agitators. Expression and not repression, lower living costs and not policemen's clubs, would smooth out the discontent in industrial centers.

Trade with Russia was discussed from three angles by ex-secretary of Commerce Redfield, David P. Barrows and Jerome Landfield. A full session was devoted to the merchant marine, the papers including an American maritime policy, marine insurance and the effect of fuel oil on foreign trade.

Exporting in general, from the problems of the export manager to the training of export salesmen and the surveying of new markets, received careful attention. The effect of the Webb law was carefully discussed as was parcel post extension in general and Pacific problems in particular.

The last session reviewed the whole national program for foreign trade, heard the report of the group sessions and of the general convention committee and adjourned, well satisfied with the great amount of interest shown and feeling that considerable progress had been made.

Some of the Papers Read

Some of the papers that were read are: "The Relation of Our Industrial Capacity to Our Foreign Trade," by James A. Farrell, chairman National Foreign Trade Council and president U. S. Steel Corporation; "Why Direct Selling," by William L. Launders, president American Manufacturers Export Association; "Methods of Surveying New Markets," by E. Wilhelm Drooster, of the Rubleins & Myers Co.; "The Work and Service of American Chambers of Commerce Abroad," by Charles W. Wittemore; "Reorganization of the Foreign Service of Our Government," by W. W. Nichols, Allis-Chalmers Manufacturing Co.; "How to Use the Federal Information Services," by E. A. Brand, secretary Tanners' Council of the U. S. A. and formerly assistant director, Bureau of Foreign and Domestic Commerce. Extracts from these papers will appear in our next issue.

*To be published in an early issue.

Labor and Industry*

By WILLIAM H. BARR
President of the Lumen Bearing Co., Buffalo, N. Y.

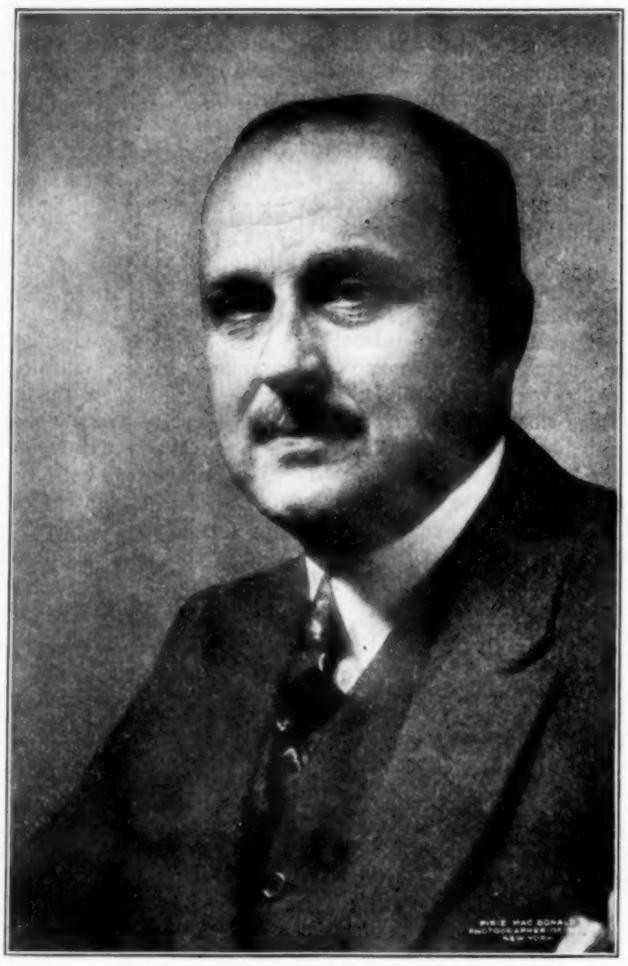
"Capital has its rights, which are as worthy of protection as any other rights. Nor is it denied that there is and probably always will be a relation between labor and capital producing mutual benefits.

"The strongest bond of human sympathy outside of the family relation should be the one uniting all working people of all nations, and tongues and kindreds. Nor should this lead to a war upon property or the owners of property. Property is the fruit of labor; property is desirable; is a positive good in the world. That some should be rich shows that others may become rich, and hence is just encouragement to industry and enterprise.

"Let not him who is houseless pull down the house of another, but let him work diligently and build one for himself, thus by example assuring that his own shall be safe from violence when built."

—The Author's quotation from Abraham Lincoln.

IN THE presentation of my subject "Labor and Industry" I have chosen a phrase which seems to be timely, although much of it must perforce be a restatement of existing fact. Industrially speaking, we are suffering from many things, not the least of which is a lack of constructive co-operative leadership. But worse indeed, we suffer from the fact that labor is under singularly short-sighted leadership; one that has no knowledge of economics; no knowledge of the political world, and having but one thing in mind, higher wages, regardless of all else. The corollary to that, is the dictum of John Mitchell, who eleven years ago said: "Not more than 200,000 men a year shall come into this country from overseas." For the American Federation of Labor leaves no stone unturned to hold the labor supply down to the most illimitable bottom, and they apparently have no conception today that they are cutting from under their feet the ground on which they wish to stand. Today, union labor is definitely aligned against industry. Obviously, of course, its position is antagonistic to its own interests, but when any set of men is filled with arrogance resulting from the feeling which success inspires, it is difficult for them to understand that their action is reflex and directed against themselves more than against those whom they single out for their antagonism. The present policy of trade unionism is one of reckless misunderstanding. If it cannot rule industry, it is willing to ruin it, forgetting that in the ruin of industry is involved the ruin of the worker.



WILLIAM H. BARR

Those who may doubt that this is a correct interpretation of the position of organized labor can verify it by studying the record of the unionists during the past few years, and particularly since the beginning of the European War. When this country recovered from the slough of industrial depression, in the spring of 1915, the unionists saw their opportunity and began a campaign to convert the necessities of the country to their own uses. Demands for higher wages began, and were continued until our entrance into the war, which precipitated a situation entirely to their liking, because they held the fate of the nation largely in their hands. During eighteen months of war, there were 5,300 union labor strikes, clearly defining their brand of patriotism. They were responsible for the epidemic of wage raising, which was a prelude to price raising. They exercised every power which they possessed to compel Government officials to bow to their will, and they almost succeeded in imposing their power upon the country. They would have accomplished this purpose if the war had lasted another year. As it is, we see the effect of their efforts, and we see the influence on themselves of the power which they had and which should now be subordinated and controlled.

But let us not misunderstand the situation, and condemn the honest workers who are members of the unions. They are merely puppets in the hands of unscrupulous leaders, and are either unwilling to or are incapable of, voicing their own views, or making affective their own silent protests against the dictatorial policy of their leaders. During the war, in order to increase membership, the ranks of the unions were thrown open to radicals and Reds, and when

*Address delivered at the convention of the American Supply and Machinery Manufacturers' Association, Atlantic City, N. J., May 17, 1920.

peace came, and the radicals had supervened in the unions, the old leaders appealed to the public to be sustained as against the outlaws which had practically captured the various organizations. But the appeal was not to co-operate in promoting justice and equity in industry, but to grant the un-American demands of the unions, in order to check the radicals. But industrial men realized that by strengthening these leaders they would strengthen those who in the heyday of their own power had attempted to strangle industry.

Every great strike in recent months has been called an outlaw strike. The coal miner's strike was disavowed by certain leaders. So was the steel strike, and so is the railroad strike. There is an object in these disavowals which is unmistakable. The unpopularity of the strikes, and the resentment of the public, was quickly apparent. Certain union leaders tried to avoid criticism by publicly proclaiming their antagonism, forgetting it was known that they were trying to carry water on both shoulders. The position of union labor today is that they have created public antagonism, but, unfortunately, they still retain their political associations, through the threat of reprisal at the polls.

Now, gentlemen, that is the point which I wish to emphasize. If you have followed developments in legislation and in industry for the past few years, you will know that whatever power labor has possessed through the unions has come from political alliances. The power of the labor union vote is negligible, but it is advertised with drums and threats, and, accordingly it has assumed a real entity for the average politician, whose business in life is counting votes before and after election. I do not ascribe venality to any of our public men, but I do ascribe weaknesses to many, which is almost as sinister, because the pliable legislator is difficult to locate and to handle. But before we condemn a public man for this weakness, we should look for the causes, of which there are at least two. One is the definite propaganda of the unionists along political lines. They are always active in the campaign for the promotion of their own interests. On the other hand, the business man pays no attention to politics. Apparently, he does not understand the issues. He may vote and he may not. If he contributes to a campaign fund he feels that he is doing all that is necessary. He is often unaware of the character of the candidates for whom he votes. He accepts a party tag without knowing whether or not the candidate is named, after consultation with a union leader. He is careless and indifferent in the exercise of his citizenship prerogatives. He is neither helpful nor hurtful to the public man. Therefore, he is ignored. He is a nonentity and does not figure as a factor in the situation.

When legislation antagonistic to commerce is enacted, the business man is indignant, forgetting that his indignation should be directed against himself and not against legislators with whom he is unacquainted.

The present political campaign is one of serious importance. We shall elect a President, who, for the sake of the country, must stand squarely on the Constitution; who must be against privilege and must be an exponent of the square deal. Unless we get back to the Constitution and a proper understanding of its principles, there are dark days ahead for industry. Legislation of the greatest importance will be considered by the next, or Sixty-seventh Congress, and the real reconstruction period will begin on March 4, 1921. To what extent are you interested in this campaign, in the selection of candidates for Congress, for the State Legislature and for the Presidency? Are you allowing someone else to name the men and tell you when and how to vote? Or, are you taking an active interest in the campaign and seeing to it that your efforts are directed towards the election of men who are sound Americans, who are against privilege and who will give special concessions to no one?

Are you aware that the labor unionists are conducting a campaign to elect a Congress in sympathy with their uneconomic demands? Are you aware that they have a campaign chest of millions of dollars, and a campaign committee of approximately 140,000 men? Do you realize what will happen to industry and business if the unionist class should dominate Congress? Pointedly, gentlemen, I ask you, what are you going to do about this vital issue?

The unionists are frank in their statements as to their objective. They would control Congress and compel the enactment of the so-called principles which they have enunciated, including the limited workday, the complete unionization of the country, the abolition of injunctions to protect property in strikes, the dilution of the power of the Courts, and the control of the judiciary and legislative machinery of the nation. If you are Americans you are against these principles, even aside from your selfish interest in them. What are you doing to prevent the success of this movement? Let me say that you have no greater duty than to take an active and direct interest in politics, to give your time, your energy and your money, not to the success of a party, but to the success of individual candidates who stand squarely on an American platform. You can all, irrespective of party affiliation, take part in this campaign. If you fail to do so, the consequences will be serious to yourself and to the international prosperity of your country.

This attempt to fasten class domination on the United States is in part due to well thought out plans which have been made effective through the weakness of Congress. The literacy test has brought about a shortage in the immigration of unskilled labor, and there is a shortage in skilled labor also. In these circumstances, the power of the unions increased, but Congress will not repeal the literacy test because it fears the menacing attitude of union labor. There seems to be no generally well understood idea concerning the labor situation and the effect which restrictions on immigration have on it. Let me read to you a statement which I prepared recently, showing the shortage of workers as a result of the dwindling of immigration during the war and because of the unnecessary and restrictive literacy test:

"Official immigration and emigration statistics for the five-year period immediately preceding the war is as follows:

"Year	Immigration	Emigration
1910	1,041,570	380,418
1911	1,030,300	518,215
1912	1,017,155	615,292
1913	1,427,227	611,924
1914	1,403,081	633,805
Totals	5,929,333	2,759,654

(To Be Concluded in Next Week's Issue.)

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

The Ryerson-Conradson Multi-Speed Planers

Joseph T. Ryerson & Son, Chicago, Ill., has added to its line the Ryerson-Conradson multi-speed planers which are being built by the Conradson Machine Tool Co. These machines are primarily designed to be motor driven as shown in Fig. 1, but they are equally efficient when arranged for constant-speed, single-pulley drive.

For motor drive a constant-speed non-reversing motor is used and is connected to the main-drive shaft by a Clark flexible coupling, and through this shaft to the reversing mechanism which is operated through pneumatic clutches. It is claimed that the type of clutch used is self-compensating for wear and requires practically no attention. Dogs on the platen trip a distributing valve alternately admitting compressed air to one or the other of the clutches. A spacing rod connects the two, and one clutch is automatically disengaged when the air is admitted to the other, thus making it impossible to lock the drive gearing. The machines are equipped for cutting speeds of 25, 30, 37½ and 45 ft. per minute and have a return speed of 100 to 120 ft. per minute. All speeds may be varied to suit special requirements.

The primary shaft carries two gears and has at its extreme end the reverse pinion which engages directly with the return clutch gear. The gears for varying the cutting speed are mounted on a square shaft and are shifted by a lever mounted in a gridiron.

The driving train, bull wheel, and rack are of herringbone design. All pinions and gears are of chrome-nickel steel heat-treated with the exception of the herringbone gears which are cast steel. All gears and bearings are automatically oiled by the splash system and the overflow of lubricant is returned to a central tank by gravity.

The bed is of the box-section type and the ways consist of V's of unequal angles, one side of each V being inclined 15 deg. to the horizontal while the other is inclined 15 deg. to the perpendicular.

Oil is carried by the bull wheel to the pockets in the V's for lubricating the ways, and each end of the bed carries a large apron extending beyond the maximum travel of the table for catching all surplus oil. The table has a central longitudinal rib for supporting the rack and cross-ribs are placed at frequent intervals.

The driving mechanism of the rack-feed, Fig. 2, consists of a piston operated pneumatically, which turns the feed-regulating disk through 180 deg.; its crank being connected by levers to a gear segment which raises or lowers the feed-rack as required. When the table trips the air-distributing valve to the clutches the air is at the same time admitted to the corresponding end of the feed-rack piston.

The elevating screws are driven by an individual

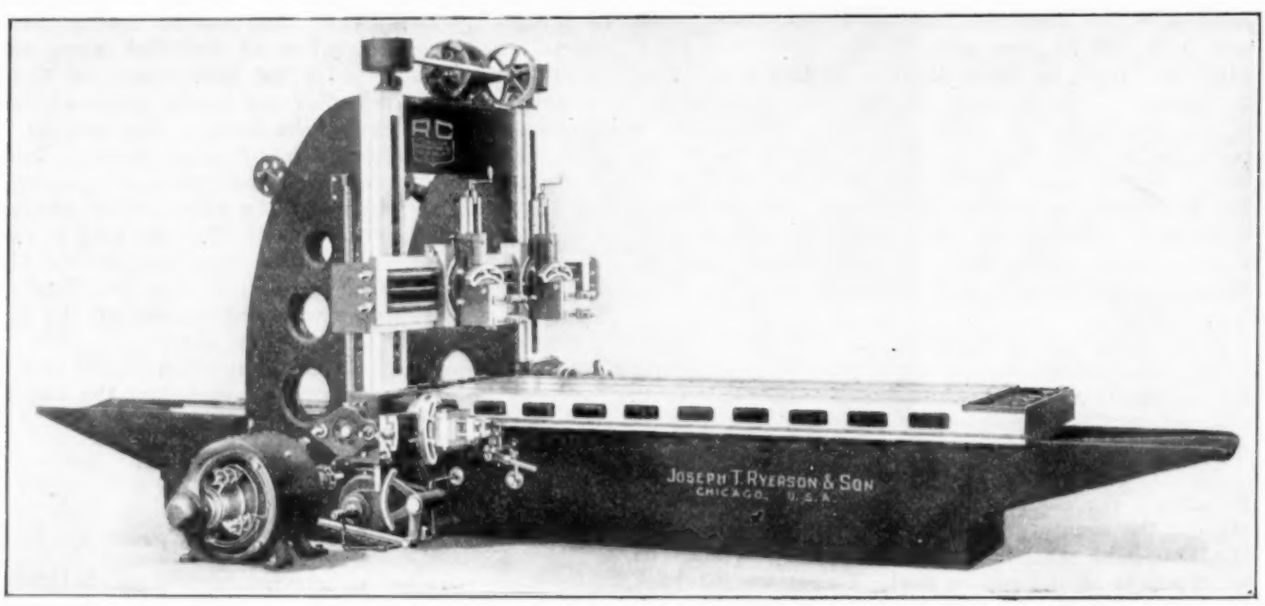


FIG. 1. RYERSON-CONRADSON MOTOR-DRIVEN PLANER

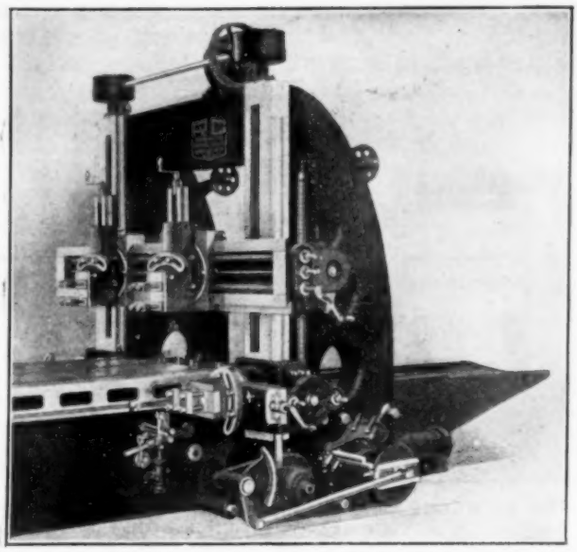


FIG. 2. CONTROL SIDE OF RYERSON-CONRADSON PLANER

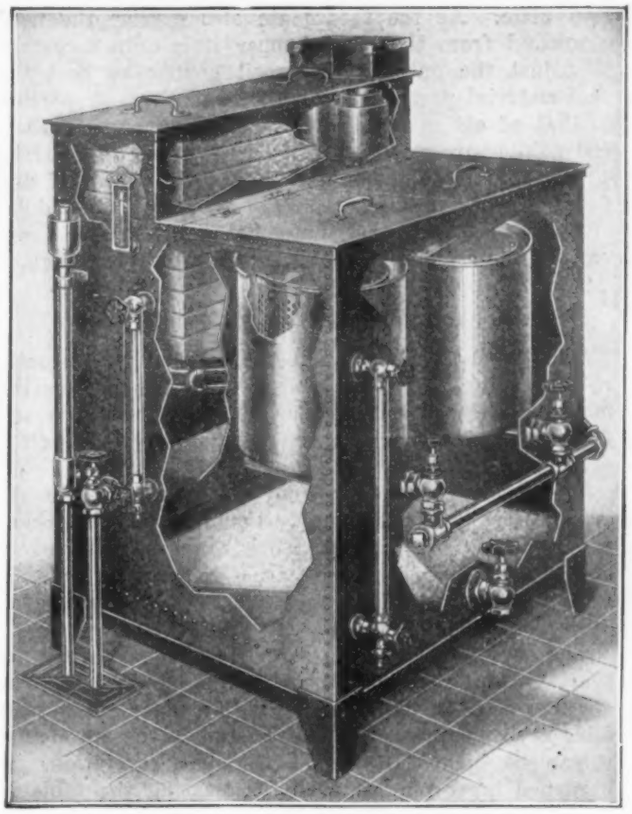
Specifications: Built in 24 x 24, 30 x 30, 36 x 36, 42 x 42, and 48 x 48 in. sizes. Respective widths between housing, 25, 31, 37, 43, and 49 in. Maximum distance from table to cross rail, 25, 31, 37, 43 and 49 in. Length of working surface of table for standard machine 6, 6, 8, 8, and 10 ft. Length of table overall 7 ft. 6 in., 7 ft. 6 in., 10 ft. 10 ft., and 12 ft. Cutting speed, 25, 30, 37½, and 45 ft. per minute. Return speed 120, 120, 100, 100, and 100 ft. per min. Speed of main-drive shaft 1,200, 1,200, 720, 720, and 720 r.p.m. Horsepower required, 3 to 5, 5 to 10, 7½ to 15, 10 to 20, and 15 to 25. Horsepower required for elevating motor, 1, 2, 3, 3, and 5. Total width without motor 5 ft. 9 in., 6 ft. 7 in., 7 ft. 9 in., 8 ft. 3 in., and 8 ft. 9 in. Total height including motor 6 ft. 8 in., 7 ft. 3 in., 8 ft. 3¼ in., 8 ft. 9½ in., and 9 ft. 3½ in. Air pressure required 80 to 100 lb. Net weight, 8,000, 11,000, 18,000, 23,000, and 32,000 lb. Weight boxed for export 9,200, 12,500, 20,500, 26,500, and 36,500 lb. Boxed for export 220, 250, 500, 750, and 1,000 cu.ft. Net weight additional for each 2 ft. length of table 1,200, 1,600, 2,000, 2,500, and 3,000 pounds.

motor mounted on the top of the tie-piece. The cross rail is of standard construction permitting individual traverse and feed of each head in either direction. Both the heads on the cross rail, and the side heads on the uprights have power angular feed and are of heavy design. The side heads have power vertical traverse. To operate the reversing clutches and rack-feed pistons, compressed air is required at a recommended pressure of from 80 to 100 lb. per square in. The air consumption will range from 3 to 10 cu.ft. of free air per minute. For shops not having a compressed-air system, a small standard compressor may be provided which is connected directly to the main-drive shaft.

Wayne Oil Filtering Cabinet

The Wayne Oil Tank and Pump Co., Fort Wayne, Ind., has added to its line the Type C oil filtering cabinet illustrated herewith. The cabinet is intended to be placed below the machines from which the oil is to be filtered so that surplus oil from the bearings will flow to it by gravity.

In entering the cabinet the oil passes through a fine brass-wire screen into a compartment where it is heated to 180 deg. F. and then into a precipitating chamber where all grit and sediment is deposited. From the precipitating chamber the oil passes through cloth filters, which remove the slime and remaining impurities, and finally into a storage tank. The object of heating the oil is to thin it so that the settling of heavy impurities will be hastened. The filter is built in four sizes for which capacities are claimed for filtering from 100 to 600 gal. of oil per hour. In addition to the cabinet shown, a tank for either fresh or filtered oil is furnished and is intended to be placed above the bearings to be lubricated so that the oil will flow to them by gravity.

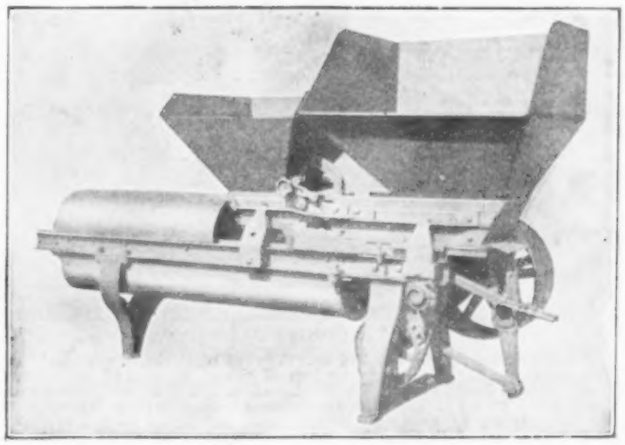


WAYNE TYPE C OIL FILTERING CABINET

Kent Carburizing-Compound Mixer

The machine illustrated herewith is made by the Kent Machine Co., Kent, Ohio, and is intended for mixing carburizing compound.

After each carburizing heat it is customary to replenish the used compound with a certain proportion of new material which, to insure uniform results, should be thoroughly mixed with the old. The large hopper holds the used compound and the small one the new material. On the throat of the small hopper there is a gate which can be adjusted to restrict the opening through which the material is carried by a reciprocating



KENT CARBURIZING-COMPOUND MIXER

feed plate. As the feed plate also carries the used compound from the large hopper it is only necessary to adjust the gate of the small hopper so that the new material passed will be in the desired proportion to that of old material and for this purposes a scale and pointer are provided. During the backward stroke of the feed plate the material on it is wiped off and falls into the mixing trough. A series of paddles attached to a horizontal shaft thoroughly mix and convey the material to the discharge-end of the trough.

Kelly 20-In. Crank Shapers

The R. A. Kelly Co., Xenia, Ohio, has recently re-designed its 20-in. crank shaper, Fig. 1 showing the machine equipped with a countershaft for belt drive and Fig. 2 showing the machine motor-driven through a gear box.

The base is of heavy construction and has a rib around the edge for catching oil and chips. The rocker arm is a semi-steel casting and is connected to the ram by means of a link, which has a tendency to pull the ram down on its bearings and thus neutralize the upward thrust of the tool.

The cross-rail elevating screw is equipped with ball bearings which take the thrust of the bevel gears. The apron is fitted to the cross rail with a taper gib and the table is so mounted on a central stud in the apron that it can be turned through a complete revolution. A hardened taper plug is used for locating the table in place.

The vise has a graduated base, and is held to the table by four bolts. A boss cast underneath the vise takes part of the downward thrust of the cut. The thrust of the screw is taken in the head of the vise, thus lessening the danger of breakage.

The feed box, located on the end of the cross rail, fully incloses the moving parts of the feed mechanism. A knurled lever on the top of the box controls the direction of feed, the table traveling in the direction the lever is thrown. The amount of the feed is controlled by the knob on the side of the box, thus no moving parts need be touched to control the amount or direction of the feed. The feed automatically disengages when the table reaches the end of its travel. All shafts are heat treated and ground, and all bearings have automatic lubrication. All gears are of semi-steel and all pinions of steel, and have helical teeth.

The machine can be furnished as shown in the illustration, or equipped with a single pulley for belt drive, either from a variable speed motor or through a gear box. It can be provided with power feed to the head and a tilting top for the table.

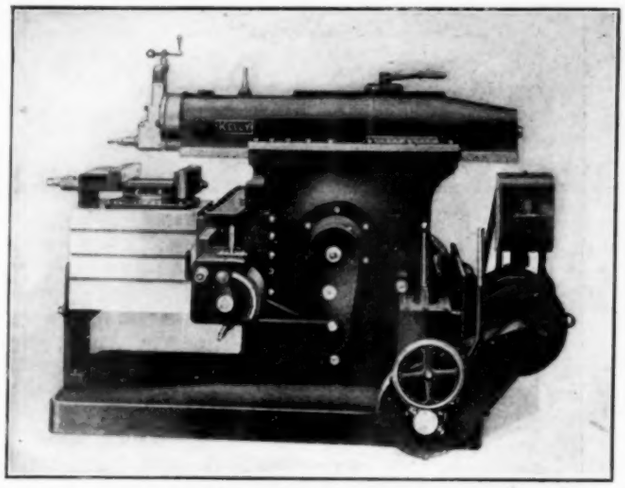


FIG. 2. KELLY 20-IN. BACK-GEARED CRANK SHAPER WITH GEARED MOTOR DRIVE

Specifications (same as for Fig. 1, except for drive). Motor: 5 hp., a.c.; speed, 1,800 r.p.m.

Cadillac Single-End Drilling and Centering Machine

The single-end drilling and centering machine shown in the illustration is built by the Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich. The spindle feed is operated by the lever on the top of the head. A sliding vise for holding the work is mounted on the

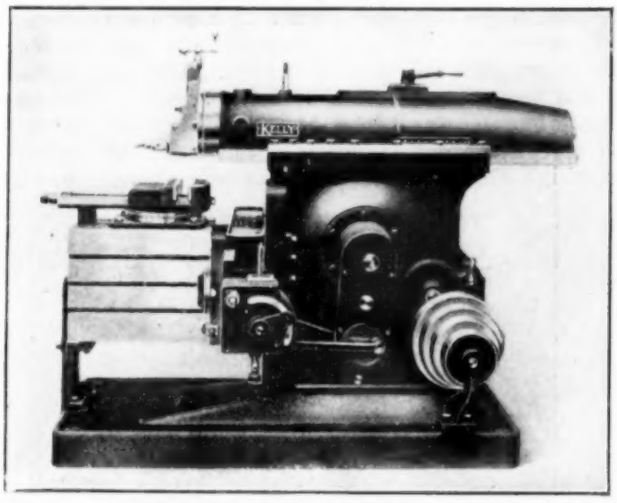
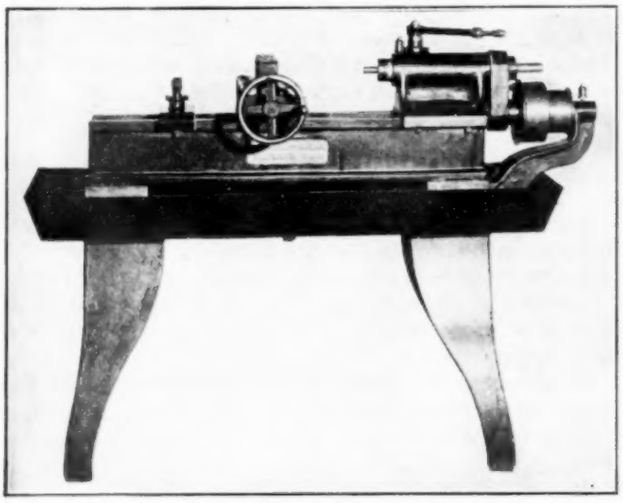


FIG. 1. KELLY 20-IN. BACK-GEARED CRANK SHAPER WITH CONE PULLEY

Specifications: Stroke, 20⅝ in. Travel of table, horizontal, 26½ in.; vertical, 12¼ in. Ram to top of table, 4½ to 16⅜ in. Down feed, 7⅛ in. Table: top, 14 x 20 in.; side, 15⅝ x 30 in. Horizontal feed, 0.007 to 0.125 in. with 18 changes. Keyseating capacity, 3½ in. dia. Ratio of gearing: single gear, 6.2 to 1; back gear, 24.6 to 1. Number of speeds, 8. Strokes per min., 6.5 to 92. Weight: net, 3,900 lb.; crated, 4,250 lb.; boxed 4,400 lb. Size of box for export, 67 x 46 x 60 in.; 104 cu.ft.



CADILLAC SINGLE-END CENTERING AND DRILLING MACHINE

Specifications: Length of bed, 44 in. Distance from ways to center of spindle, 5¼ in. Capacity of standard vise, 4-in. round or hexagon stock. Spindle: speed, 750 to 1,740 r.p.m.; axial movement, 4 in.; nose fits No. 3 Jacobs chuck. Countershaft: pulley, 6 x 2¾ in.; speed, 1,050 r.p.m. Motor required, ½-hp., 1,150 r.p.m., constant speed; or ½-hp., 900 to 1,800 r.p.m., variable speed.

ways, and a support or stock-rest is furnished for sustaining the outer end of the work.

The machine may be furnished either belt-driven, as illustrated, or with a motor drive. When furnished with belt drive a two-speed countershaft is part of the regular equipment. The countershaft and loose pulley are provided with Hyatt roller bearings. All other bearings of the machine are bronze-bushed, with suitable provisions for oiling. The drilling capacity of the machine is ¾ in. when drilling steel. An oil pump with tank and piping, drill chuck, special jaws and fixtures can be furnished as extra equipment.

Ingersoll Reciprocating Type Milling Machines

The Ingersoll Milling Machine Co., Rockford, Ill., has developed milling machines of a reciprocating type which are shown in the illustrations. Since each

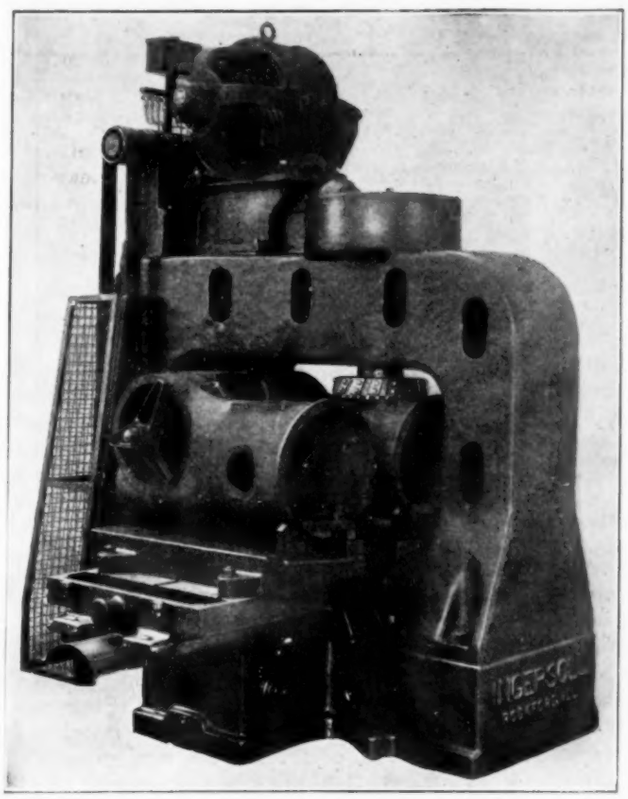


FIG. 1. INGERSOLL RECIPROCATING-TABLE MILLING MACHINE FOR TRACTOR TRANSMISSION HOUSINGS

Specifications: Casting finished, 20 x 21 x 38 in. Table, 30 x 60 in. Feed, 8 in. per min. Rapid traverse, 10 ft. per min. Cutter sizes, horizontal, 8 in.; vertical, 10 in. Floor space 7 ft. 6 in. x 9 ft. Weight 15,000 lb.

machine is built to suit the particular piece of work upon which it is to be used, there is no attempt at standardization of design beyond employing as many standard parts as the design warrants.

In the use of reciprocating types of milling machines, duplicate pieces of work are mounted on opposite ends of the table and alternately fed to the cutters. While a cut is being made on the work on one end the operator places work on the other end. When one cut is finished the table is returned by a rapid traverse motion and, as it approaches the fresh piece of work, automatically resumes its normal rate of feed. This reversal of feed and rapid traverse continues indefinitely while

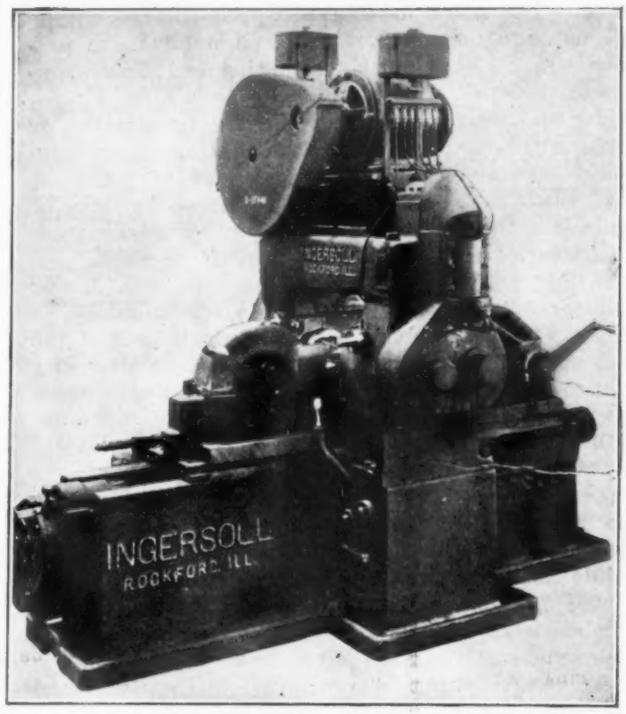


FIG. 2. FOUR-SPINDLE RECIPROCATING-TABLE MILLING MACHINE

Specifications: Four spindles. Tables, 14 in. x 4 ft. Floor space, 23 sq.ft. Height, 78 in. Weight 12,000 lb.

the operator alternately loads work on the opposite ends of the table.

The machine, Fig. 1, was designed for milling tractor transmission-housings, using one vertical spindle with a 14-in. cutter and one horizontal spindle with an 8-in.

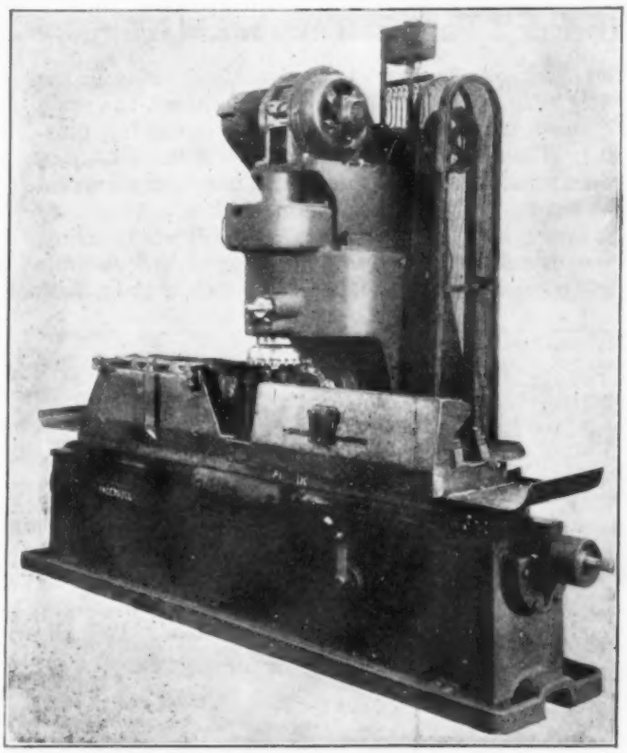


FIG. 3. OPEN-FRAME RECIPROCATING-TABLE MILLING MACHINE

Specifications: Two spindles. Twelve-inch cutters. Table, 14 in. x 6 ft. Feed, 6¼ in. per min. Rapid traverse, 10 ft. 6 in. per min. Floor space, 36 sq.ft. Height 8 ft. Weight 10,000 lb.

cutter. The latter finishes a flanged surface on the side opposite the observer. Special fixtures are provided which aid in quickly mounting and firmly supporting the work.

The spindles are controlled directly by starting or stopping the motor, but the table motion can be controlled separately by feed levers, one of which is mounted on each end of the bed so that either may be available to the operator while loading. The table feeds can be varied to suit the character of the work.

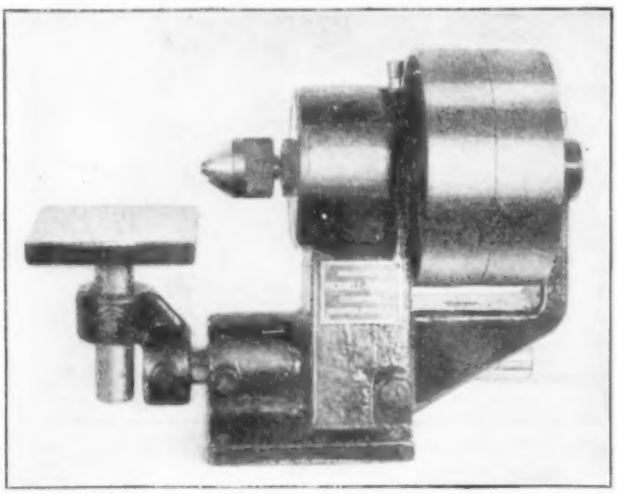
Another reciprocating type of machine, Fig. 2, was built for milling opposite ends of a transmission-case cover. This casting has shoulders which prevent the work passing clear through the housing. Four cutter spindles are provided and arranged in pairs so that one pair takes care of the work on one end of the table, the other pair running idle while work is being loaded on the opposite end.

The machines are also built in the openside type, Fig. 3, and while similar to the other types in general construction, they have an advantage in accessibility for loading work of certain character. The machine shown is used for milling four surfaces on a gas engine cylinder-block. The first two surfaces are milled by placing the casting in the left-hand fixture. After this operation the casting is transferred to the right-hand fixture and its other sides are milled, while a fresh casting is being loaded on the opposite end of the table, so that after the first one has been finished, two castings are always in process, one being loaded while the other is being milled.

The machine has both vertical and horizontal spindles. All cutter spindles on the machines are adjustable and the feed control is centralized in a single lever on the front of the bed.

Bicknell-Thomas Tapping Machine

The Bicknell-Thomas Co., Greenfield, Mass., has recently added to its line of tapping machines, the small plain bench machine shown in the accompanying illustration. The machine is furnished with either a friction drive or a positive drive, the mechanism being inclosed in the head. The friction-drive machine has a capacity up to ⅜-in. taps, while the positively driven machine can accommodate taps up to ¾ in. in size. The machine is driven by means of a 6-in. pulley and a 1½-in. belt.

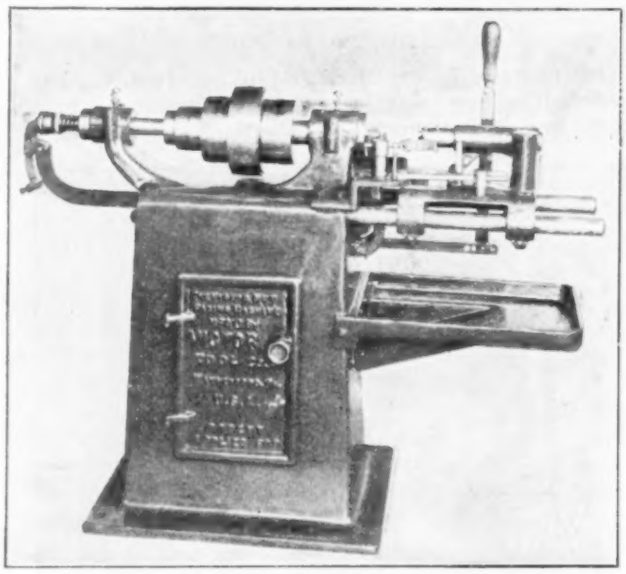


BICKNELL-THOMAS PLAIN BENCH TAPPING MACHINE

The work table slides horizontally on a splined steel shaft, which is held in position by a pilot screw. An adjustable stop is provided, so that holes may be tapped to a uniform depth. The work tabie can be adjusted for height, and also removed so that any special work-holding fixture required may be mounted in its place.

Victor No. 0 Nut-Facing Machine

The Victor Tool Co., Inc., Waynesboro, Pa., has recently added to its line of nut-facing machines, a No. 0 machine for facing small-sized nuts. This machine, shown in the accompanying illustration, holds the nut



VICTOR NUT-FACING MACHINE NO. 0

Specifications: Size of nuts handled, ¼ to ⅝ in. Spindle: speed, 990 r.p.m.; taper hole, No. 3 Morse; bearings, dia., front 2¼ in., rear 1¾ in. Floor space, 47 x 16 in. Weight with countershaft: net, 470 lb.; for domestic shipment, 525 lb.; for export, 700 lb. Measurements, boxed for export, 60 x 30 x 40 in.

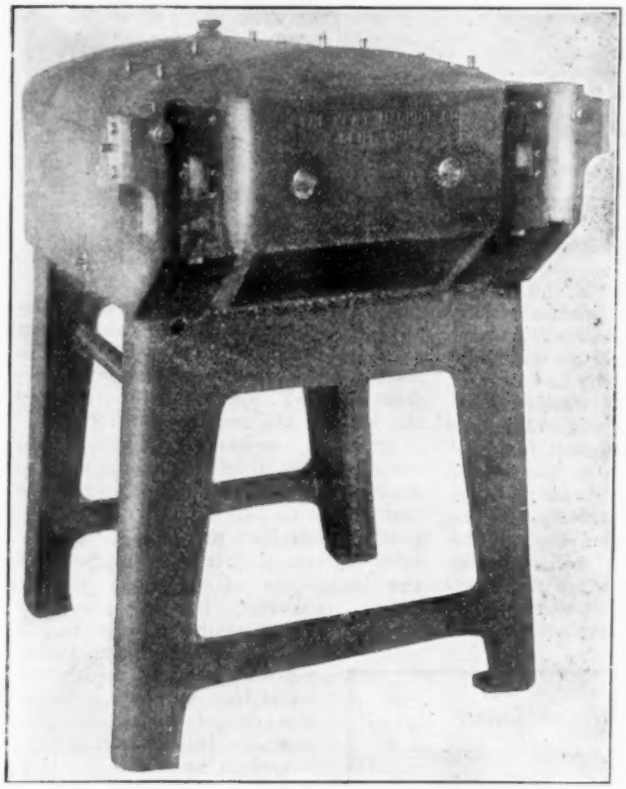
on a hardened threaded mandrel and against an equalizing collar. The carriage holding the cutters is moved forward by means of the lever shown at the right. After the nut is faced, the facing head is withdrawn by means of the lever, which also operates a friction clutch that reverses the spindle. Fingers attached to a yoke hold the nut while the mandrel unscrews from it. Instead of feeding the nuts directly on the mandrel by hand, they are inserted one by one into a magazine, from which they are automatically fed on the mandrel, eliminating the danger of injury to the operator's hands. It is claimed that an average production of twenty ¾-in. nuts per minute can be obtained.

Kent Semi-Automatic Pointing Machine

The Kent Machine Co., Kent, Ohio, has brought out the two-spindle pointing machine illustrated herewith.

The machine will point bolts or rods up to ¾ in. diameter and of any length over 1½ in. Only one operator is required as all he has to do is to enter the work in the gripping chucks, all other operations being entirely automatic. The spindles are cam actuated and one is moving forward while the other is moving backward, allowing the operator to place work alternately in the chucks.

After the work has been placed in one of the chucks



KENT TWO-SPINDLE SEMI-AUTOMATIC POINTING MACHINE

it is gripped by the jaws; the spindle moves forward bringing the cutter to the work, then recedes; the chuck jaws then open, allowing the work to drop out. The pointing heads are made of steel and are provided with slots in which the cutters are inserted and securely held by self-adjusting clamps. Guide bushings for various sizes of work are furnished.

It is claimed that the machine will point bolts or rods at the rate of 50 per minute. The machine occupies a floor space of 31 x 41 in. and weighs 1,100 lb.

Diamond Tools for Truing Abrasive Wheels

The Tungsten Tool Co., Inc., 110-114 West 42nd St., New York City, is putting on the market diamonds mounted in nibs as shown in the illustration herewith.

The diamonds are mounted in drill-rod nibs by a patented process in which no hot metal is used, thus avoiding danger to the stones from excessive heat.

The nib in the center has been partly cut away and shows the diamond closely held by its matrix.

TUNGSTEN TOOL CO.'S DIAMOND-POINTED TOOLS

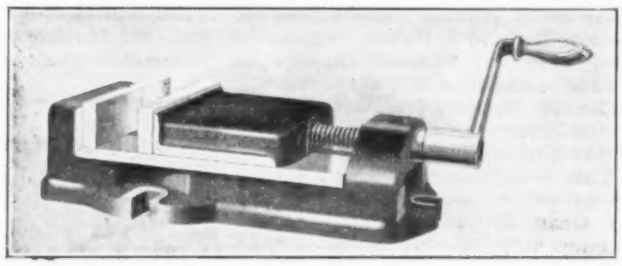
It is claimed that a diamond set by this process can be of almost any size or shape and that it will be so firmly held as not to be loosened by any work it may be called upon to do, also that there is no need to reset the stone when worn down to the steel setting, the intention being to have the wheel cut away both the stone and the metal setting until the stone has been two thirds used.

Diamonds can be furnished in various grades and sizes mounted in nibs to fit the holders used in all standard makes of grinding machines.

Hoosier Drilling- and Milling-Machine Vises

The Hoosier Drilling Machine Co., Goshen, Ind., has brought out a line of machine vises, one of which is illustrated herewith.

The jaws are faced with hardened steel, unless otherwise specified. On the bottom of the vise body a milled



HOOSIER DRILLING- AND MILLING-MACHINE VISES

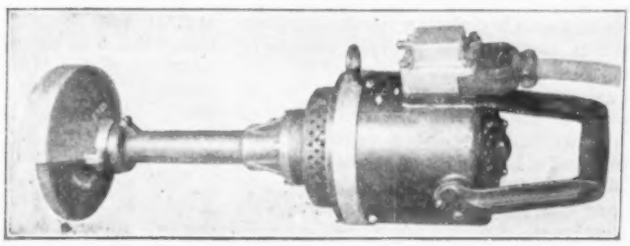
Specifications: Built in three sizes, Nos. 1, 2 and 3. Widths of of jaws, 5¾, 7¼, 8¾ in. Depths of jaws, 1½, 2 and 2½ in. Maximum opening of jaws, 3¼, 4¼ and 7 in. Weights, 45, 90 and 175 lb.

slot, running the entire length, has been provided for alignment when attaching the vise to the machine table. The body is also provided with slotted bolt-flanges for use in securing the vise to the table of the machine tool.

Van Dorn Aerial Grinder

The Van Dorn Electric Tool Co., Cleveland, Ohio, has added to its line the aerial grinder illustrated herewith.

The grinder has a 12-in. extension carrying the abrasive wheel well out from the frame. Power is transmitted from the armature shaft to the wheel arbor through an equalizing coupling, allowing smooth running. Ball bearings are used throughout and lubrication is by grease applied at three accessible points. The end bearings are protected by felt grease-washers. The device is made with either of the following motors: d.c. ½ hp. 110-220 volts, 4,000 r.p.m.; a.c. polyphase, ¼ hp. 110-220 volts, 3,600 r.p.m.; a.c. single phase, ½ hp. 110-220 volts, 3,600 r.p.m. Equipment comprises one 6 x 1 x ½-in. wheel, wheel guard, 10-ft. electric cable, attachment plug and suspension spring. Weight, 26½ to 31 lb.



VAN DORN AERIAL GRINDER

Delegates to International Chamber of Commerce Sail

The American members of the organization committee for the International Chamber of Commerce sailed for Paris on May 9. They are:

A. C. Bedford, chairman of the Board of the Standard Oil Co., and member of the National Foreign Trade Council, New York, chairman; S. C. Mead, secretary of the Merchants' Association of New York, vice chairman and secretary; Thomas W. Lamont of J. P. Morgan & Co.; Edward A. Filene, president of William Filene's Sons Co., Boston; Richard S. Hawes, president of the American Bankers' Association, St. Louis, and John H. Fahey of Boston, formerly president of the Chamber of Commerce of the United States.

This delegation will meet similar delegations appointed by Great Britain, France, Belgium and Italy, to agree upon a Constitution for the proposed Chamber. The new chamber will hold its first meeting early in June. President William Fellowes Morgan will go to Paris for the purpose of attending that meeting with Mr. Mead on behalf of the Merchants' Association. The creation of the International Chamber was agreed upon at the International Trade Conference in Atlantic City last October, under the auspices of the Chamber of Commerce of the United States. It is proposed that the members of the International Chamber shall meet every two years, and that the Chamber shall take the place of the International Congress of Chambers of Commerce and Commercial Organizations, which held two meetings before the outbreak of the war.

A permanent bureau will be established to maintain contracts between sessions and to gather authoritative statistics. In discussing this bureau, Mr. Fahey, just before sailing, said:

"The permanent bureau will provide means of following up the results secured from biennial sessions of the chamber, the decisions business men arrive at as to legislation needed in their various countries to provide necessary progress. There will be, out of this development, machinery constantly at work the year around. As a result of the disturbed conditions following the war, there is hardly a country whose statistical information is worth the paper it is written on—our own, as well as the rest.

"All their government bureaus and institutions have been affected by the war, thousands and thousands of new employees are still months and months behind in their work, and necessary information on which business men must do their reckoning is not available. It is not brought up to date and, as a matter of fact, as conditions exist between one nation and another, is co-ordinated in no intelligent fashion."

While the committee is meeting in Paris, delegates from Great Britain, Belgium, China, Japan, Italy, Greece, Portugal, Brazil, Finland, Poland, Rumania, Czechoslovakia and Jugoslovakia will meet in Paris for the International Parliamentary Conference of Commerce, which was created upon the initiative of Great Britain before the outbreak of the war. It held its first meeting in Brussels in 1914, and it has met since then in Paris, London or Brussels each year, excepting in 1915. This conference will discuss a large number of important international questions.

The United States was invited to send representatives to the conference, but it has not replied to the invitation.

Russian Militarization of Labor

The State Department has issued the report of Leon Trotzky, made at Ninth Congress of Russian Communist Party, as published in Moscow Izvestia, of March 21. It says in part: "At the present time the militarization of labor is all the more needed in that we have now come to the mobilization of peasants as the means of solving the problems requiring mass action. **We are mobilizing the peasants and forming them into labor detachments which very closely resemble military detachments.**"

Material Handling Machinery at the New York Electrical Show

Practically every type of machine used in handling freight shipments at the steamship piers and railroad terminals, will be exhibited at the Electrical Exposition to be held at the Grand Central Palace in October.

These exhibits which are to be a special feature of the show will be presented and demonstrated under the auspices of the Material Handling Machinery Manufacturers' Association, which has spared no pains or trouble in making this big industrial exhibit comprehensive to the last detail.

This will be the first time that the Electrical Show has specialized to any degree in one particular branch of electrical machinery.

Machine-Tool Situation in Denmark

The demands of the Danish industries for machine tools are being taken care of by American, German, British and Swedish manufacturers who, besides Danish manufacturers, supply the bulk of the required machinery.

There is, however, a decided recovery of the Danish machine-tool industry noticeable of late which is mainly due to two reasons. First, import of American machines has somewhat decreased lately on account of the high rate of exchange of the dollar, rendering further purchases from American manufacturers rather costly. Second, German competition, against which the home industry had a rather hard stand during the last year, is fast losing ground, inasmuch as prices for German machinery are almost 100 per cent in excess of those quoted by British manufacturers, a fact which is largely accounted for by the steadily increasing wage demands of the German workmen, rendering many products unexportable.

While German welding machines still dominate the Danish market, Danish manufacturers have not been slow in turning the opportunity caused by the aforementioned facts into practical advantage. There is a marked tendency on the part of Danish manufacturers to prevent foreign makes from further penetrating Danish industries, though it is rather doubtful whether or not the home manufacturers will be able to satisfy the demands of the Danish industries.

Construction of lathes and milling machines, for instance, is being resumed on a large scale and further extended, as is occasionally revealed by the business reports of the larger companies. Cost prices of Danish machinery are largely a matter of raw materials, coal and wages. Raw materials and coal having to be imported from abroad, they naturally loom large, considering the present high rate of exchange.

The price for coal ranges within 160-200 Kr. per ton f.o.b. factory, depending upon whether being shipped at the reduced rates of the so-called freight board or at the higher rates charged by companies not under the administration of that board. Altogether, the importance of the Danish market to American manufacturers should not be lost sight of.

LD'S INDUSTRIAL FORGE
News Editor

War Claims Board Experts Turn to Industrial Work

At the suggestion of a prominent Government official, the most active members of the Technical Advisory Committee, who were chiefly instrumental in the settling of more than three billion dollars' worth of war contract claims for the War Claims Board, have decided to offer their services to the industries of this country and recently opened headquarters at 132 Nassau St., New York. The majority of these engineering experts are New Yorkers and because they became widely known through their connection with the Governmental work, they have organized themselves under the name of the Technical Advisory Corporation. In the course of their war claims work they touched every branch of American industry, as the claims ran from small ammunition to the greatest power developments ever made.

Civil Service Examination for Safety Engineer

The United States Civil Service Commission, Washington, D. C., announces an open competitive examination for safety engineer on June 22. A vacancy at the Amatol Arsenal, Hammonton, N. J., at $2,500 to $3,000 a year, and vacancies in positions requiring similar qualifications, at these or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. The entrance salary within the range stated will depend upon the qualifications of the appointee as shown in the examination, and the duty to which assigned. For further information write to the commissioner at Washington, D. C.

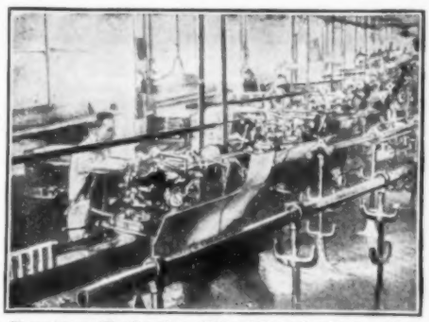
A Co-operative Banquet

The Victor Co-operative Club of the Victor Saw Works, Inc., Springfield, Mass., held a banquet recently. During the course of the evening each department reported on the work accomplished to date this year, which proved that they were all working on an altogether efficient basis. The different departments pledged themselves to continue to co-operate with each other to the greatest possible degree with an aim to exceed all records heretofore shown. It was voted to hold these get-togethers more often in the future than in the past, as these affairs help to stimulate enthusiasm in the members of the organization.

Thousands to Get Free Trips to Sullivan Plants

The Sullivan Machinery Co. believed that workers and engineers would have a better appreciation of its machines if they could be shown just where and how the machines are made. Being impossible to get the thousands of men to visit its Claremont, N. H., and Chicago plants, it was decided to place the plants aboard the celluloid magic carpet and take the industries around to the men. The Rothacker Film Manufacturing Co., of Chicago, was selected to make the film.

A three-reel film was completed in time to do considerable work this spring



Courtesy Rothacker Film Manufacturing Co.

AUTOMATIC TURRET LATHES IN SULLIVAN MACHINERY COMPANY'S SHOPS

in schools and this summer will be loaned to engineering societies, etc.

The Sullivan picture opens with panoramic views of the Claremont and Chicago works. The interior of the Claremont foundry and the pouring of air compressor castings are next shown. The air compressors, made at both the Claremont and Chicago plants, are then followed through the various stages of machining, assembly, erection and the final testing at full speed and load before shipment. Interesting details include the gigantic planer at Chicago on which twelve angle compound air compressor frames are planed at one operation; the assembling of water valves and of finger valves used in the different compressors; and the steam valve action on one of the company's 2,500 Corliss compound air compressors, in which the operation of the Corliss valve gear is clearly shown.

The second part of the picture is entitled "How Hammer Drills Are Made." The observer is shown the automatic machinery by which the different parts are milled, shaped, and ground to the close fits needed in this class of machinery. Materials are shown under test and the completed machine is finally shown at work.

Changes in Manning, Maxwell & Moore Corporation

At the regular monthly meeting of the board of directors of Manning, Maxwell & Moore, Inc., held on May 19, 1920, Percy M. Brotherhood, senior vice president of the corporation, was appointed executive vice president with the powers and duties attaching to the duties of president, succeeding Alfred J. Babcock, resigned on account of ill health. Mr. Brotherhood has been actively associated with Manning, Maxwell & Moore, Inc., for over twenty-five years and during recent years has been senior vice president in charge of the machine-tool business of the company. Eugene Maxwell Moore was recently elected vice president in charge of foreign sales. Henry D. Carlton was elected a director of the corporation, following his recent election to the office of vice president in charge of the brass goods sales, succeeding the late John N. Derby. Robert A. Bole, Pittsburgh district manager, was also elected a director.

National Engineering Societies Growing Rapidly

The membership of the National Engineering Societies has forged ahead rapidly since the signing of the armistice.

The latest membership figures are as follows:

American Society of Civil Engineers, 9,515 (May 4, 1920).

American Institute of Mining Engineers, 8,532 (May 10, 1920).

American Society of Mechanical Engineers, 12,258 (May 14, 1920).

American Institute of Electrical Engineers, 11,345 (May 1, 1920).

Society of Automotive Engineers, 4,798 (May 8, 1920).

Critical Ranges of Nickel Steels

The Bureau of Standards has printed a twenty-page pamphlet on "Critical Ranges of Some Commercial Nickel Steels."

This pamphlet may be obtained by addressing a request for Scientific Paper No. 376 to the Department of Commerce, Bureau of Standards, Washington.

Licensing of Engineers in New York State

The bill for the licensing of professional engineers and land surveyors in New York State, was passed by the Legislature April 24, and signed by the Governor on May 14, 1920.

Patent Office Salary Bill's Passage Insured

With the reporting to the Senate of the bill providing for an increase of the force and salaries in the Patent Office and the measure fixing a policy for dealing with inventions and patents developed by Government employees, the final enactment of these important pieces of legislation is practically insured.

The bill provides for a net increase of $511,840 in the amount to be paid in salaries to Patent Office employees. At the present time the Patent Office is far behind in its work as it has been found impossible to keep an organization of trained men with the existing salary scale. The increase of salaries is more than compensated for by the increase of fees.

The Senate already has passed the bill dealing with inventions by Government employees. In order to expedite that measure, however, it was added to the bill increasing the salaries in the Patent Office, thereby throwing that bill into conference without having to wait for its passage by the House. Since there is no objection to the measure in the House it is practically certain to become a law. The reasons for enacting the legislation dealing with inventions developed by Government employees, and other matters, are as follows:

The reasons for the enactment of this bill and its aims may be summarized as follows:

1. There is no fixed or general policy dealing with inventions and patents developed by Government employees in the course or as a result of their official duties, and consequently no governmental administrative machinery for translating such inventions and patents into actual public service.

2. In cases where patents are developed by the combined efforts of Government employees and others, difficulties at present arise concerning the administration of the same because of the conflict between the rights of the inventors and those of the United States.

3. There is no way at present by which patentees in or outside the Government service can dedicate their patents to the public with the assurance that the public will reap the full benefit therefrom, because an invention covered by a patent so dedicated does not interest capital, and because it may be excluded from public use by patents subsequently taken out by others.

4. Conditions brought about by the war, causing an unprecedented demand for inventions, and the industrial developments and readjustments now following the war, call imperatively for guidance. Also the host of inventions developed during the war in the many Government bureaus and other organizations, primarily for war purposes, but which have a peace application of inestimable value, should be co-ordinated, conserved, and translated into industrial use.

5. There is herewith provided a means aimed to be acceptable to the medical profession of patenting and consequently properly controlling inventions in the field of medicine and surgery, the control of patents by private interests being contrary to the ethics of the medical profession.

6. It is desirable to have governmental administration of a certain type of patents, not ordinarily attractive to manufacturers, in order to provide production of needed devices or materials for governmental or public purposes.

7. The President, under the authority of Congress, has set a precedent for the proposed legislation by authorizing and directing the Federal Trade Commission to administer enemy-owned patents.

8. The patent administration here contemplated provides for revenue sufficient to cover the expenses of its operation.

9. Provision is made for some remuneration to patentees, to stimulate invention.

Prospect of Trade With Russia Wanes

Agitation within the ranks of American business for the immediate reopening of trade between the United States and Russia has waned considerably within the past few weeks and at the State Department little pressure is being continued by export interests for Government action.

Lessened interest in Russia appears to be the result of recent advices from Europe to the effect that the country is not as attractive as American business men were led to believe by reports of agents of the Soviet government.

Engineering in Russia Given Attention

On Wednesday, May 26, 1920, in the Engineering Societies' Building, New York, a joint meeting of the various American Societies of Engineers was held, the subject being the resources and the engineering of Russia. Walter N. Polakov of the A.S.M.E. presided, while N. A. Stephanoff, president of the Russian Society of America, in the first speech told of engineering instruction and the status of engineers in Russia.

W. F. Dickson, director of the Russian Singer Co., who has been in Russia for over 20 years, told of some of the achievements of Russian engineers. J. M. Goldstein, Professor of Economics, Moscow University, gave an illustrated lecture upon the resources of Russia and the development of them in the past.

All of the men who spoke pointed out the value to the engineering profession of a liaison between the engineering societies of Russia and America, and they urged co-operation in engineering affairs for the advantage of both countries.

Spencer the Philosopher Opposed Metric System

Herbert Spencer, the great English philosopher, the centenary of whose birth has just been observed, was an uncompromising opponent of the metric system. A clause in his will provided for republishing his pamphlet against the system whenever the question of its adoption should come up in Parliament. In this pamphlet he introduces an argument between an imaginary advocate of the system and himself, some of the knotty questions he puts being, "What do you propose to do with the circle at present divided into 360 degrees?" "Why do you not make ten months instead of twelve?" and "You have not proposed to substitute ten hours for twelve. Why not?" To which last he himself replies triumphantly, "People will refuse to replace their old watches with new ones."

The Page Steel and Wire Co., New York, announces change of its central district sales office from 29 South La Salle Street to 208 South La Salle Street, Chicago.

Tentative Program for the National Conference of Business Paper Editors

The program for the National Conference of Business Paper Editors, to be held at the Congress Hotel, Chicago, Ill., on June 4, 1920, is announced as follows:

(Papers will be limited to 15 minutes, the opening discussion to 5 minutes and all other discussions to 3 minutes.)

Morning Session

9:30 a.m. Registration.

9:45 a.m. A word of welcome by Clay C. Cooper, Mill Supplies, Chairman, Business Paper Editors' Association of Chicago.

10:00 a.m. Improving the Appearance of our Editorial Pages (a discussion of the possibilities of raising the standards of typography, illustrations and make-up to make our papers more attractive and interesting to the busy reader), by C. J. Stark, managing editor, *Iron Trade Review*, Cleveland.
Discussion led by B. H. Ikert, editor, *Motor Age*, Cleveland.

11:00 a.m. Where To Get Editors (journalists versus technical or trade specialists), by F. M. Feiker, vice-president, McGraw-Hill Co., Inc., New York.
Discussion led by E. T. Howson, *Railway Age*, Chicago.

11:45 a.m. How I Expand My List of Contributors, by Charles Dobbs, *The Insurance Field*, Louisville, Ky.
Discussion led by A. H. Brayton, *Merchants Trade Journal*, Des Moines, Iowa.

A question box will be open during the morning session for the receipt of questions which will be answered at the afternoon session.

1:00 p.m. Buffet luncheon at the Congress Hotel, as guests of the Business Editors Association of Chicago.

Afternoon Session

2:00 p.m. Executive session to discuss the real facts concerning the present situation and the future business outlook in:
(Scheduled discussions limited to 7 min., others to 3 min.)
The Iron and Steel Field—W. W. Macon, *Iron Age*, New York.
The Engineering-Construction Field—H. P. Gillette, *Engineering & Contracting*, Chicago.
The Automotive Industry—Clyde Jennings, *Automotive Industries*, New York.
Agriculture and Food Products—Alson Secor, *Successful Farming*, Des Moines, Iowa.
The Financial & Banking Field—J. M. Regan, *Bankers Monthly*, Chicago.
Business Conditions in the Foreign Field—A. D. Anderson, *Boot & Shoe Recorder*, Boston.
The Transportation Field—Samuel O. Dunn, *Railway Age*, Chicago.
The Field of General Business—L. R. Thomas, *Factory*, Chicago.

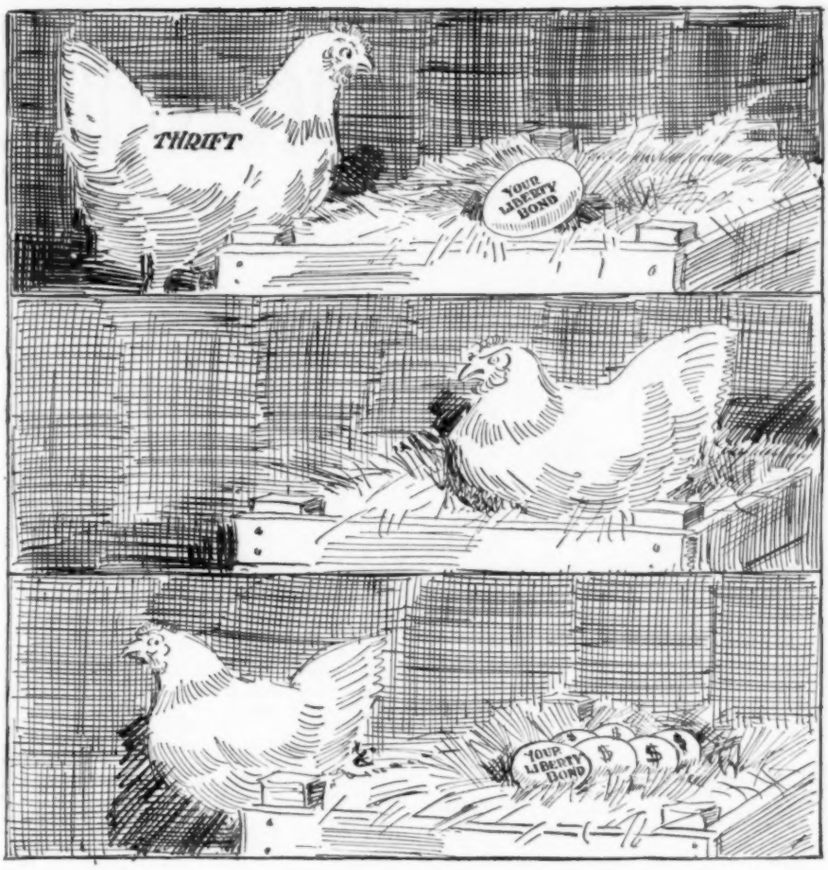
3:30 p.m. The Duty of the Editor in Interpreting the Present Business Situation for His Readers, by Richard H. Edmonds, *Manufacturers Record*, Baltimore.

Evening Session

6:30 p.m. Informal dinner at the Congress Hotel, to which members of the business departments of the trade and technical papers will also be invited. Douglas Malloch, *American Lumberman*, toastmaster.

8:00 p.m. The Paper Situation and the Outlook for the Future, by B. W. Anderson, Whitaker Paper Co., Chicago.

8:45 p.m. A discussion of the Breakdown in the Postal Service and its Remedy, led by E. C. Hole, *American Lumberman*, Chicago.



Business Items

The Electric Rod Mills, Inc., Rome, N. Y., has been merged with the Rome Wire Co., Rome, N. Y.

The Clark Equipment Co., Buchanan, Mich., manufacturer of high-speed drills and tools, will continue its policy, granting vacations with pay to all its employees. All employees with the company for one year will be allowed one week's vacation with full pay; vacations start on June 1.

The Worthington Pump and Machinery Corporation, New York, announced that in addition to the well-known lines of hydraulic machinery which it has manufactured since 1840, it has now completed preparations to furnish improved water-power machinery of all capacities for low-, medium- and high-head service, including oil-pressure system, water-wheel governors and other auxiliaries.

The Rome Manufacturing Co., Rome, N. Y., has increased its capital from $850,000 to $3,000,000. P. C. Thomas, Rome, N. Y., is president.

To render more efficient service and distribution in the Southwest territory, the Chicago Flexible Shaft Company has opened a St. Louis office in the Railway Exchange Building, in charge of Otto Bersch and Jack Stroman, both of whom are capable metallurgical engineers.

The Precision and Thread Grinder Manufacturing Co., Philadelphia, Pa., manufacturer of the Multi-Graduated Precision Grinding machines, announces that the United States patent on the machine was issued May 1, 1920.

The Standard Electric Tool Co., of Cincinnati, Ohio, has opened a branch office for the New York district in the Grand Central Palace, 44th St. and Lexington Ave., New York.

The Henry & Wright Manufacturing Co., of Hartford, Conn., manufacturer of its ball-bearing sensitive drilling machines and dieing machines, is now occupying the offices and showroom formerly leased by Hill, Clarke & Co., Inc., at 136 Cedar St., New York. Besides its own product it will carry a complete line of machine tools.

K-G Welding and Cutting Co., of 556 West 34th St., New York, manufacturer of welding and cutting apparatus, has opened a sales office at 12-14 E. Harrison St., Chicago, Ill., in order to accommodate its western trade.

Westinghouse, Church, Kerr & Co., Inc., has announced the removal of its offices from 37 Wall St., to 125 East 46th St., New York.

Kimelblatt, Ross & Sisti, Inc., has announced that after June 1 it will occupy new quarters at 117 Charles St., New York.

Hardinge Brothers, Inc., of Chicago, Ill., manufacturer of the Cataract line of precision bench lathes, is now being represented in New York by the Henry & Wright Manufacturing Co.

Personals

N. N. BAAD, who formerly had charge of the heat-treating department at the De La Vergne Machine Co., of New York, has resigned to accept a position as sales and service engineer with the F. A. Calhoun Co., 76 Montgomery St., Jersey City, N. J.

J. J. SHEEHAN has been made head of the curry department of the Graton & Knight Manufacturing Co., of Worcester, Mass., leather belting manufacturer.

FRANK SUESS, formerly New York manager for Hill, Clarke & Co., Inc., is now connected with Henry & Wright Manufacturing Co. in the same capacity.

E. E. BALDWIN, of New York and formerly employed by the Eagle Lock Co., has taken up his duties as sales manager with the Corbin Screw division of the American Hardware Co. Mr. Baldwin is a brother of Carl H. Baldwin, a vice president of the American Hardware Co.

B. L. CLEGG, who has been connected with the Westinghouse Electric Co., of 265 Broadway, New York, for the last eleven years, is now associated with the industrial department and is specializing in motors adapted for machine shops.

L. M. BAKER has resigned as supervisor of sales in the motor equipment division of the Hyatt Roller Bearing Co., to accept the position as exclusive representative in the State of Michigan for the Dittmer Gear and Manufacturing Corporation, Lockport, N. Y. Mr. Baker was also associated with the Bearing Service Co., as well as being sales manager of the United Motors Service Co., Inc. He will have his headquarters in the Book Building, Detroit, Mich.

Forthcoming Meetings

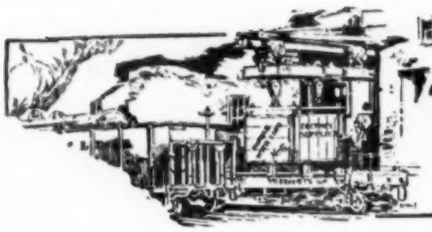
The Railway Supply Manufacturers Association will hold an exhibit on Young's Pier at Atlantic City, June 9 to 16, in conjunction with the annual mechanical conventions of the American Railway Association. Many of the leading machine-tool builders of the country will be among the 330 or more exhibitors.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25, inclusive.

The American Steel Treaters' Society will hold a convention in Philadelphia, Sept. 14 to 18. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is the secretary.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$30.75
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	26.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	30.90
Grey Forge	43.50*	30.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.35
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–6.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60–6.05	7.17@8.05	4.62	7.65	7.07
No. 14	3.65–6.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.15–6.30	8.50@9.50	5.30	8.20	7.80
Nos. 22 and 24	4.20–6.35	8.55@9.55	5.35	8.25	7.85
No. 26	4.25–6.40	8.60@9.60	5.40	8.30	7.90
No. 28	4.35–6.50	8.70@9.70	5.50	8.40	8.00
Galvanized					
No. 10	4.70–7.50	9.75@11.00	5.50	8.50	8.15
No. 12	4.80–7.60	9.85@11.00	5.55	8.60	8.20
No. 14	4.80–7.60	9.85@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10–7.90	10.10@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25–8.02	10.25@11.55	6.05	9.05	9.05
No. 26	5.40–8.20	10.40@11.70	6.20	9.20	9.20
No. 28	5.70–8.50	10.70@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 1/8, 5/32, 3/16, No. 8, 7/32 and No. 10	21.00 to 30.00	1/4 by 12 in. long	14.00
1/4		1/4 by 19 in. long	12.00
No. 12		5/16 by 19 in. long	10.00
5/16, No. 14 and 3/8		3/8 by 21 in. long	10.00
No. 18		**Special Welding Wire, Coated**	
No. 20		1/16	33.00
		1/8	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 7/32, 8½c. per lb.; 1/4, 8c.; 5/16 to 1/2, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.50@7.00	8.00	9.00
Spring steel (light)	11.50	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Steel			Iron	
Inches	Black	Galvanized	Black	Galvanized
BUTT WELD				
1/8, 1/4 and 3/8	47%	20½%	34½%	18½%
1/2	51%	36½%		
3/4 to 3	54%	41½%		
LAP WELD				
2	47%	34½%	28½%	14½%
2½ to 6	50%	37½%	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS				
1/8, 1/4 and 3/8	43%	25½%	34½%	19½%
1/2	48%	35½%		
3/4 to 1½	52%	39½%		
LAP WELD, EXTRA STRONG PLAIN ENDS				
2	45%	33½%	29½%	16½%
2½ to 4	48%	36½%	31½%	19½%
4½ to 6	47%	35½%	30½%	18½%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
¼ to 3 in. steel butt welded	40%	24%	40%	31%	54%	40½%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50%	37½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.25	18.50	16.50
Tin in 5-ton lots	50.00	61.00	72.50
Lead	8.80	8.87½	5.25
Spelter	7.50	8.50	6.60
ST. LOUIS			
Lead	8.60	8.50	5.00
Spelter	7.50	7.95	6.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

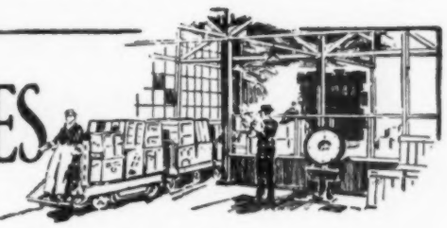
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	29.50	29.50	23.00	32.00	24.50	36.00	26.00
Copper wire (carload lots)	31.25	29.25	23.00	29.50	24.00	27.00	22.00
Brass sheets	27.50	26.50	20.50	29.00	24.00	27.00	21.50
Brass pipe	32.00	32.00	30.75	34.00	31.00	35.00	31.00
Solder (half and half) (case lots)	43.00	39.00	38.00	40.50	43.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	18.00
New York	23.75	19.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill..... 12.00

	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	14.45	15.50	14.80
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	9.37½	6.75
Chicago	11.50	9.00
Cleveland	12.50	7.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —		—Cleveland—		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy, and crucible	16.25@16.75	13.75	16.50	14.00	16.00
Copper, heavy, and wire	15.50@16.00	12.75	16.50	13.00	15.00
Copper, light, and bottoms	14.00@14.50	11.00	15.00	11.00	14.00
Lead, heavy	7.00@7.25	4.00	7.00	4.50	7.00
Lead, tea	5.00@5.50	3.25	5.00	3.50	6.00
Brass, heavy	9.50@10.00	8.50	12.50	9.00	16.50
Brass, light	8.00@8.50	6.50	10.00	6.50	10.00
No. 1 yellow brass turnings	9.25@9.75	7.50	10.00	7.00	10.00
Zinc	5.00@5.25	4.50	5.00	4.00	6.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	33.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	26.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	87.00	74.50	79.00	70.00	75.00
Commercial	50.00	42.00	21.50	17.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$4.00	3.25	$ .75	$1.90	$.50	2.00
Hot pressed hexagon	+ 4.00	2.70	.75	1.90	.50	2.00
Cold punched hexagon	+ 4.00	3.25	.75	1.90	.50	1.30
Cold punched square	+ 4.00	2.70	.75	1.90	.50	1.30

Semi-finished nuts, ⅜ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	List	40%	30%
Larger and longer up to 1½ in. by 30 in.	+20%	20—10%	20%

WASHERS—From warehouses at the places named the following amount is deducted from list price:
For wrought-iron washers:
New York..... list Cleveland..... $3.00 Chicago..... $3.00
For cast-iron washers, ½ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	10%	35%	20%
Larger and longer up to 1 in. by 30 in.	10%	20%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	25%	10%	10%
Chicago	10%	10%	10%	10%
New York	25%	40%	5%	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	40%	35–10%
Tinned	30%	40%	35–10%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York...$7.00 Cleveland...$4.00 Chicago....$5.37 Pittsburgh...$4.72
Structural, same sizes:
New York...$7.10 Cleveland...$4.10 Chicago....$5.47 Pittsburgh....$4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	32.00	34.00	35.00
Brass	30.50	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $8.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$2.25	$1.75
Philadelphia	2.75	2.00	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.50	2.25	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.40	$3.65
Philadelphia	3.65		
Cleveland	4.25	4.25	3.62
Chicago	5.00	5.00	5.00

COKE—The following are prices per net ton at ovens, Connellsville:

	May 27	May 20	May 13
Prompt furnace	$13.00@$14.00	$11.00@$12.00	
Prompt foundry	14.00@15.00	12.00@13.00	

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York —		Cleveland	— Chicago —	
	Current	One Year Ago		Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.75	$1.59	$2.00	$2.05	$1.78
5-gal. cans (without cans)	1.78*	1.72	2.25	2.30	1.98

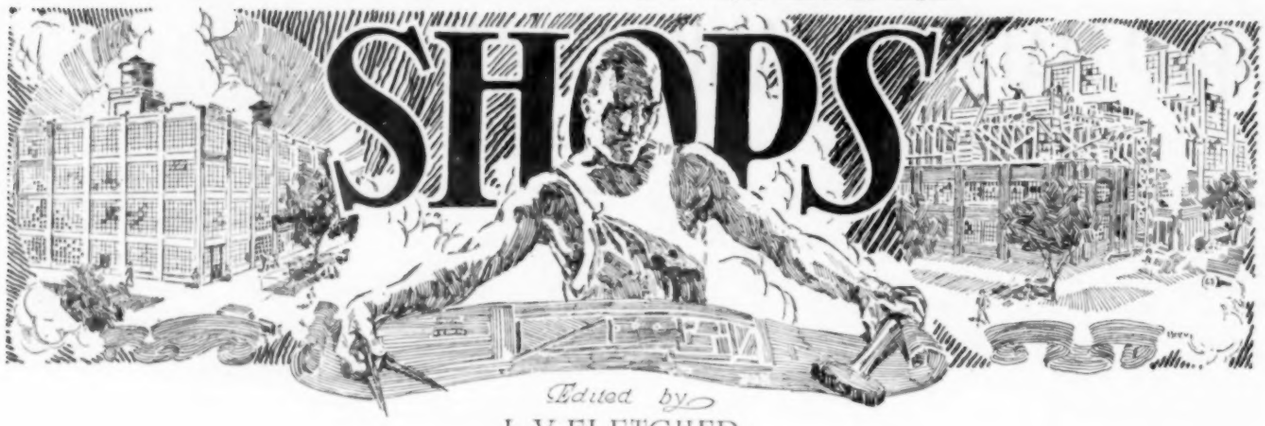
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW *and* ENLARGED



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., Hartford—The City of Hartford, c/o Fire Comrs.—machine shop equipment.

R. I., Woonsocket—R. G. Carle, 384 North Main St.—9 punches.

D. C., Washington—The Bureau of Ordnance, Navy Dept., schedule 6199—two 60 in. x 12 ft. center lathes and one 72 in. x 12 ft. center lathe.

Md., Baltimore—The Harvey Co., 113 South St. H. C. Busick, Purch. Agt.—32 ft. bending rolls for 1 in. plate, motor drive d.c. (new or used).

N. J., Hilton (Newark P. O.)—E. O. Storms, 302 Boyden Ave.—one small star lathe and one small drill press.

N. J., Newark—The Van Sickelen Speedometer Co.—one 36 in. power driven squaring shear.

One 24 x 24 in. hand screw press, New Britton or equivalent.

One 1 x 5 in. six speed lathe, geared head (new or used).

N. Y., Buffalo—The Great Lakes Pressed Steel Corp., 1400 Niagara St., G. Adolphson, Purch. Agt.—press for forming auto bumpers.

N. Y., Buffalo—The Jones Iron Wks., 308-314 Terrace, A. C. Wolfe, Purch. Agt.—one bolt cutter.

N. Y., Buffalo—E. Klas, 514 Howard St.—one 20 to 24 in. pony planer and one 30 to 36 in. band saw.

N. Y., Buffalo—A. W. Kreinheder, Comr. Pub. Wks., Municipal Bldg.—one lathe, 16 in. swing, one milling machine, one drill press, one planer, and one shaper.

N. Y., Buffalo—The Willard Machine Wks., 73 Forrest Ave., M. D. Willard, Purch. Agt.—one No. 2 Cincinnati universal mill and one 30 to 36 in. radial drill, American preferred.

N. Y., New York (Borough of Brooklyn)—The Hopewell Insulation and Mfg. Co., 555 Eastern Parkway—miscellaneous machine tools including hydraulic presses.

N. Y., New York (Borough of Manhattan)—A. R. Brown-McFarlane Co., Ltd., 120 Bway.—lathes, planers, punches, shears and general line of machine tools for shipyard in Japan.

N. Y., New York (Borough of Manhattan)—The Konig Bros. & Co., 82 Beaver St.—machine tool equipment for sugar mill in Cuba, including—

One 24 in. x 24 ft. heavy duty belt drive engine lathe, 3 step cone, double back geared with countershaft, large and small face plates steady rest, change gears and necessary wrenches.

One 20 and one 12 in. chuck.

One set of tapered Morse bushings, No. 1 to No. 5.

One 30 in. x 8 ft. belt driven planer with countershaft and standard equipment.

One 4 ft. belt driven radial drill with countershaft and standard equipment.

One 6 to 12 in. pipe threading machine, belt driven, with standard equipment.

One set of pipe dies for above machine for 6, 8, 10 and 12 in. pipe, also cut off die.

One 2½ to 6 in. pipe threading machine, belt driven with standard equipment.

One set of pipe dies for above machine for 3, 4, 5 and 6 in. pipe, also cut off die.

One ¼ to 4 in. pipe threading machine, belt driven, with standard equipment.

One set of pipe dies for 1¼, 1½, 2, 2½, 3 and 4 in. pipe, also cut off die.

N. Y., New York (Borough of Manhattan)—The United Electric Light and Power Co., 55 Duane St., T. E. Murray Consult. Engr.—one 110 ton and one 75 ton overhead traveling crane for Hell Gate Station.

N. Y., Syracuse—The Burr Fowler Co., 145 Seymour St.—drills, taps and dies.

N. Y., Syracuse—The Improved Garage Co., 105 Canal St., W. F. Albrecht, Mgr.—two Bliss punch presses No. 20 and No. 21½ (new or used).

Pa., Bethlehem—The Bethlehem Shipbuilding Co., for Sparrows Point, Md.—one motor driven nipple threading machine, capacity 1¼ to 6 in. pipe, and one motor driven saw for wrought iron pipe of 12 in. diameter.

Pa., Philadelphia—The Pennsylvania Equipment Co., 1420 Chestnut St.—vertical belt driven boring mill for general railroad shop use.

Va., Roanoke—The Norfolk & Western R.R.—two 32 in. motor driven crank planers.

Ill., Chicago—The Chicago, Milwaukee & St. Paul Ry. Co., Ry. Exch. Bldg., W. A. Lynn, Purch. Agt.—$35,000 worth of machine tools.

Ill., Chicago—E. R. Norman, 3341 Michigan Ave.—lathes and grinders.

Ill., Quincy—The Channon Emery Stove Co.—power presses for manufacture of oven and boiler and drip pans.

Mich., Detroit—The Cost Cut Counter Bore Co., 74 East Fort St.—boring mill and miscellaneous tool equipment.

Mich., Detroit—The Square D Co., 1400 Rivard St.—presses and large squaring shears to take sheets up to 36 in. wide.

Mich., Detroit—The Walker Saxe Motor Car Co., 1515 Gratiot Ave.—small tool equipment for motor repair.

O., Columbus—The Amer. Motor Mfg. Co., 35½ North High St., B. B. Hatcher, Pres.—one 2 spindle, heavy duty, column type drilling machine, capacity ¾ in., ball or roller bearing, belt driven; one universal milling machine with universal dividing head, table feed about 26 in. and cross feed 8 in.; ½ in. sliding head, sensitive bench drills and one plain hand miller, floor type without arbors.

Wis., Amery—The Amery Auto Co.—drill press and tire welder.

Wis., Milwaukee—J. Bernert—759 North 33rd St.—one punch press and one riveter.

Wis., Milwaukee—The Lutter & Gies Co., 258 Lake St., H. Lutter, Pres.—one 60 in. B. & S. automatic gear cutter.

Wis., Milwaukee—The Milwaukee Eng. and Tool Co., 70 West Water St., A. R. Polaski, Purch. Agt.—shaper, lathe and drill press.

Wis., Milwaukee—Wilging & Koehler, 1612 Tentonia Ave.—one 24 to 30 in. planer, sticker to work 7 in. material.

Mo., St. Louis—The Fairbanks Co. Market and 7th Sts.—one 21 to 24 in. sliding head drill press with tapping attachment.

Tex., Dallas—J. L. Barrett—press punch, shear and brake for No. 12 iron up to 34 in. width (new or used).

Machinery

The following concerns are in the market for machinery:

Conn., Bridgeport—The Summerhill Tubing Co. c/o H. McMurtrie, 1012 Walnut St., Philadelphia—equipment for the manufacture of steel tubes.

N. J., Newark—The Bd. Educ., City Hall—manual training equipment.

N. J., Trenton—The Karno Smith Co., Broad St. Bank—$100,000 worth of machinery for the Thermoid Rubber Co., Whitehead Rd.

Pa., Lebanon—The Lebanon Steel Foundry—wood working machinery.

Mich., Detroit—The Aero Cushion Inner Tire and Rubber Co., 909 Ford Bldg. A. S. O'Shaunessie, Purch. Agt.—equipment for manufacture of solid rubber fillers for automobile tires.

Mich., Detroit—The Bell Pump and Mfg. Co., West Fort and Beaubien Sts.—short ends of ¾ in. rods, 20 in. or longer.

Mich., Detroit—The Columbia Motors Co., Beaufait and Mack Aves.—conveyors, escalators, hoists and general equipment for automobile factory.

Mich., Detroit—The Wildman Rubber Co., Book Bldg.—complete equipment for manufacture of tires.

Mich., Dowagiac—The Premier Warm Air Heater Co.—moulding machinery and foundry equipment.

O., Columbus—The Bd. of Administration of the Ohio Penitentiary, West Spring St., I. D. Lyons, Purch. Agt.—complete equipment for shoe repairing plant.

O., Columbus—The Excelsior Seat Co., West 5th Ave., D. E. Pittenger, Mgr.—wood working machinery and paint sprayer.

O., Columbus—The Ironclay Brick Co., 63 Ruggery Bldg., J. M. Adams, Mgr.—motor mixing machine and gravity conveyors.

O., Kenton — The Champion Eng. Co., c/o Foundation Co., Fulton Bldg., Pittsburgh, Pa.—one 60 ft. traveling crane for 400 ft. building and one jib crane for 200 ft. building.

Wis., Milwaukee—The Amer. Tool Chest Co., 54th St. and Lisbon Ave., J. LaVies, Purch. Agt.—one 18 to 24 in. polisher, motor driven.

Wis., Port Washington—The Turner Mfg. Co.—traveling crane.

Wis., West Allis—The Allis Chalmers Mfg. Co.—traveling crane for yard work.

Cal., San Diego—The Citrus Soap Co., 902 K St.—machinery for the manufacture of soap, washing powder and glycerin.

Ont., London—The London Hosiery Co., Adelaide St.—knitting machinery.

Ont., Seaforth—The Canada Flax Mills Co.—machinery for the manufacture of flax, electric motor drive.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Summerhill Tubing Co., c/o H. McMurtrie, Archt., 1012 Walnut St., Philadelphia, will soon award the contract for the construction of a 2 story, 60 x 120 ft. factory for the manufacture of steel tubes

Conn., Elmwood (Hartford, P. O.)—The Abbott Ball Co. has awarded the contract for the construction of a 1 story, 50 x 80 ft. addition to its plant for the manufacture of steel balls. Estimated cost, $18,000.

Conn., Hartford—The City of Hartford c/o Fire Comrs., has had plans prepared by Whiton & McMahon, Archts., 36 Pearl St., for the construction of a 2 story, 50 x 125 ft. machine shop on John St. Estimated cost, $125,000. Noted Apr. 29.

Conn., Higganum—The Cutaway Harrow Co. plans to build an addition to its plant for the manufacture of agricultural implements. Estimated cost, $100,000.

Conn., Meriden—C. Collington, 81 Crown St., is having plans prepared by H. L. Sprague, Archt., 310 Main St., Springfield, Mass., for the construction of a 1 story, 80 x 125 ft. garage on Cook Ave. Estimated cost, $60,000.

Conn., New London—A. Grippo, 6 Truman St., will build a 3 story, 40 x 100 ft. garage and show room on Bank and Truman Sts. Estimated cost, $50,000. Noted Mar. 25.

Conn., Waterbury—The R. K. Brown Estate, 26 East Main St., will soon award the contract for the construction of a 1 and 2 story, 72 x 120 ft. garage on Meadow St. Estimated cost, $35,000.

Mass., Boston—The J. W. McGuire Co., 745 Boylston St., will soon award the contract for the construction of a 3 story, 80 x 300 ft. sales and service station on Commonwealth Ave. Estimated cost, $400,000. Appleton & Sterns 53 State St., Archt.

Mass., Everett—The Crocker Pen Co., 167 Oliver St., Boston, will soon award the contract for the construction of a 1 story, 60 x 120 ft. addition to its plant. Estimated cost, $30,000.

Mass., Lowell—G. R. Dana, 2 East Merrimack St., has awarded the contract for the construction of a 1 story garage on East Merrimack St. Estimated cost, $125,000.

Mass., Lynn—Peterson Bros., 250 Western Ave., have awarded the contract for the construction of a 1 story, 80 x 80 ft. garage on Western Ave. and Chestnut St. Estimated cost, $25,000. Noted Apr. 29.

Mass., Roxbury — D. Fineburg, Old South Bldg., Boston, will build a 1 story, garage on Humboldt Ave., here. Estimated cost, $100,000.

Mass., Worcester—T. Hanson, 873 Main St., is having plans prepared by E. Chapin, Archt., State Mutual Bldg., for the construction of a 3 story 90 x 90 ft. garage. Estimated cost, $75,000.

Mass., Worcester—The Rogers Drop Forging Co., Frank St., has awarded the contract for the construction of a plant, to include a 1 story, 130 x 150 ft. forge shop, a 1 story, 60 x 85 ft. sand blasting building and a 40 x 50 ft. boiler house. Estimated cost, $125,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Baltimore & Ohio R. R., Baltimore and Charles Sts., has awarded the contract for the construction of a 1 story, 28 x 140 ft. and 12 x 42 ft. car shop, office and tool room at its Mt. Clare shops on Pratt and Poppleton Sts. Estimated cost, $100,000.

Md., Cumberland—The Crystal Laundry Co., Baltimore St., has awarded the contract for the construction of a 1 and 2 story, 130 x 284 ft. laundry, garage and power house. Estimated cost, $200,000. Noted Apr. 22.

N. J., Bordentown—The State of New Jersey has awarded the contract for the construction of a 1 story, 42 x 110 ft. workshop addition at the Bordentown Industrial School. Estimated cost, $29,250.

N. Y., Buffalo—The Amer. Radiator Co., 1807 Elmwood Ave., has had plans prepared for a 1 story, 25 x 120 ft. addition to its factory. Estimated cost $7,500.

N. Y., Buffalo—The Crosby Co., 183 Pratt St., plans to build a sheet metal stamping plant on Spring St. Estimated cost, $100,000.

N. Y., Buffalo—The Donner Steel Co., 475 Abbott Rd., has had plans prepared for a 67 x 83 ft. extension to its plant. Estimated cost, $10,000.

N. Y., New York (Borough of Brooklyn)—The Brandenburg Bros., 382 Hamilton Ave., will build a 1 story garage on Lorraine St. near Hamilton Ave. Estimated cost, $12,000.

N. Y., New York (Borough of Brooklyn)—Coombs & Wilson, 32 Court St., will build a 1 story, 50 x 100 ft. garage on Wykoff Ave. and Stockholm St. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—F. Huber, 314 Park Ave., Brooklyn, has awarded the contract for the construction of a 2½ story, 100 x 100 ft. garage on Grand Ave. Estimated cost, $50,000. Noted Apr. 15.

N. Y., New York (Borough of Brooklyn)—F. McCurdy, 189 Montague St., will build a 1 story, 100 x 150 ft. garage on Empire Blvd. and Bedford Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—A. Pinover, 16 Court St., will build a 200 x 294 ft. garage, service station and show room on Bedford Ave. and Sullivan St. Estimated cost, $150,000.

N. Y., New York (Borough of Brooklyn)—The Randaz Realty Corp., 34 Nassau St., New York City, will build a 1 story, 100 x 100 ft. garage at 233-243 Empire Blvd. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—A. A. Wemmell, 833 Sterling Pl., will build a 1 story, 75 x 135 ft. garage on Atlantic and Sheffield Aves. Estimated cost, $40,000.

N. Y., New York (Borough of Manhattan)—The Thompson Bros. Co., 42 East 142nd St., will build a 2 story, 100 x 100 ft. garage on 144th St. and Lenox Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Queens)—The Factory Constr. Co., 44 Court St., Brooklyn, will build a 1 story, 50 x 80 ft. garage on 13th St. and Crescent Ave., Long Island City. Estimated cost, $35,000.

N. Y., New York (Borough of Queens)—The W. Klein Iron Wks., 65 Bway. Long Island City, will build a 2 story factory on Verona and Webster Aves., to have 10,000 sq.ft. floor space. Estimated cost, $55,000.

N. Y., Niagara Falls—The Electrometallurgical Co., Union St., has had plans prepared for the construction of a 1 story factory. Estimated cost, $10,000.

N. Y., North Tonawanda—The Niagara Radiator Co. has awarded the contract for the construction of a 1 story, 70 x 190 ft. factory. Estimated cost $150,000.

Pa., Lebanon—The Lebanon Steel Foundry is building a 50 x 119 ft. pattern shop and storage room at its plant. Estimated cost, $20,000. K. V. Wheeler, Mgr.

Pa., New Castle—The Castle Fdry. Co. recently organized with $100 000 capital stock, is building a factory for the manufacture of castings. F. Sowersby, 409 Garfield Ave., and H. Connor, 3403 7th Ave., are incorporators.

SOUTHERN STATES

N. C., Raleigh—J. L. O'Quinn has awarded the contract for the construction of a 1 story, 71 x 80 ft. garage. Estimated cost, $50,000.

MIDDLE WEST

Ill., Chicago—The Chicago Solder Co., 218 North Union Ave., has awarded the contract for the construction of a 2 story, 50 x 250 ft. addition to its factory. Estimated cost, $100,000. Noted Jan. 29.

Ill., Chicago—The Magnetic Motors Corp., 2521 Calumet Ave., plans to build a 1 story factory on 34th Pl. and Cottage Grove Ave., for the manufacture of gasoline motors. Estimated cost, $150,000.

Ill., Lawrenceville—The A. L. Maxwell Co. is having preliminary plans prepared by Fowler & Coppelle, Archts., 409 Amer. Trust Bldg., Evansville, Ind., for the construction of a 2 and 3 story garage. Estimated cost, $70,000.

Ind., Sullivan—The Mutual Truck Co. is having plans prepared by D. B. Shourds, Archts., Tribune Bldg., Terre Haute, for the construction of a 400 x 750 ft. factory.

Mich., Detroit—J. Schevitz, 195 Ferry Park Ave., has awarded the contract for the construction of a 1 story, 60 x 150 ft. garage and service station on Willis Ave. Estimated cost, $30,000. Noted May 20.

Mich., Detroit—The Walker Saxe Motor Co., 1515 Gratiot Ave., will soon award the contract for the construction of a 1 story, 119 x 135 ft. garage and service station. Estimated cost, $40,000.

Mich., Dowagiac—The Premier Warm Air Heater Co. is building a 120 x 360 ft. factory. Estimated cost, $100,000. H. Wood, Mgr.

O., Cleveland—The Cleveland Welding and Mfg. Co., West 117th St. and Berea Rd., will soon award the contract for the construction of a 1 story, 90 x 155 ft. addition to its factory. Estimated cost, $75,000.

O., Cleveland—The DeMooy Palmer Co., East 55th St. and Sweeney Ave., has awarded the contract for the construction of a 1 story, 50 x 150 ft. foundry. Estimated cost, $25,000.

O., Cleveland—The Holan Mfg. Co., 3809 Clark Ave., manufacturer of truck bodies, has awarded the contract for the construction of a 1 story, 43 x 104 ft. and 41 x 100 ft. drying kiln and mill, at 5600 Parkbrook Rd. Estimated cost, $100,000.

O., Cleveland—The Imperial Metal Products Co., 4903 Harlem Ave., has awarded the contract for the construction of a 1 story, 34 x 46 ft. addition to its factory on East 49th St. and Harlem Ave. Estimated cost, $30,000.

O., Cleveland—The Modern Aluminum Fdry. Co., 4613 Payne Ave., has awarded the contract for the construction of a 1 story, 50 x 143 ft. addition to its factory. Estimated cost, $50,000.

O., Cleveland—The Natl. Lamp Co., Nela Park, has awarded the contract for the construction of a 2 story, 38 x 78 ft. addition to its factory at 1760 East 45th St. Estimated cost, $65,000. F. Terry, Mgr.

O., Cleveland—The Natl. Malleable Castings Co., Woodhill Rd. and Quincy Ave., has awarded the contract for the construction of a 1 story, 100 x 500 ft. kiln on Woodhill Rd. Estimated cost, $250,000.

O., Cleveland—The Natl. Woolen Co., 3157 West 33rd St., has awarded the contract for the construction of a 2 story, 50 x 107 ft. machine and engine room. Estimated cost $50,000.

O., Euclid—The Goff Kirby Coal Co., Electric Bldg., Cleveland, is preparing plans for the construction of a 3 story garage, stable and warehouse. Estimated cost, $150,000.

O., Fostoria—The Seneca Wire and Mfg. Co. has awarded the contract for the construction of a 1 story, 208 x 536 ft. factory.

O., Kenton—The Champion Eng. Co. has awarded the contract for the construction of a 1 story, 60 x 400 ft. and 20 x 160 ft. addition to its iron works. Cost between $150,000 and $160,000.

O., Lakewood—The Cleveland Cartage Co., 1394 Hird Ave., plans to build a 2 story warehouse and garage on Berea Rd. Estimated cost, $100,000. J. C. DeVenne, Pres.

O., New Philadelphia—The Wise McClung Co., manufacturer of washing machines, will soon award the contract for the construction of a 3 story factory. Estimated cost, $300,000. W. S. Ferguson Co., 1900 Euclid Ave., Cleveland, Engr. and Archt. Noted Mar. 18.

Wis., Kenosha—The Winthor Motor Truck Co., North Shore Rd. has awarded the contract for the construction of a 1 story, 60 x 385 ft. factory.

Wis., North Milwaukee—The Bernert Mfg. Co., 489 12th St., Milwaukee, is having preliminary plans prepared by J. Glaser, Archt., 713 Caswell Blk., Milwaukee, for the construction of a 1 story, 60 x 120 ft. foundry.

WEST OF THE MISSISSIPPI

Ia., Waterloo—Deere & Co., 1325 3rd Ave., is building a foundry plant to include two 1 story, one 2 story and one 3 story buildings, to have 56,400 sq.ft. floor space. Estimated cost, $400 000.

Minn., Minneapolis—The Modern Foundry and Machine Co., 4725 Dupont Ave., is preparing plans for the construction of a 1 story, 80 x 150 ft. iron and steel foundry on Hiawatha Ave. Estimated cost $60,000. L. J. Bedard, Pres.

Tex., Port Neches—The Hydraulic Mchy. Mfg. Co. plans to build 3 story, 60 x 140 ft. factory for the manufacture of portable turbines, motors, etc. Estimated cost, $75,000.

CANADA

Ont., Belleville—The Springer Lock Mfg. Co., Coleman St., is having plans prepared by B. Jarvis, Archt., 8 Campbell St., for the construction of a factory for the manufacture of locks. Cost between $25,000 and $50,000.

Ont., Toronto—The Gendron Mfg. Co., 137 Duchess St., is having plans prepared by J. P. Hynes, Archt., 107 Castle Frank Rd., for the construction of a 2 story, 40 x 50 ft. office building and a 1 story, 80 x 200 ft. factory on Pharmacy Ave., for the manufacture of baby carriages. Cost between $250,000 and $300,000.

Ont., Toronto—The Riverdale Garage Co., Ltd., Danforth Ave., plans to build a 2 or 3 story garage. Estimated cost, $90,000. J. C. Nicholson, Pres.

General Manufacturing

NEW ENGLAND STATES

Mass., Brockton—The Puritan Shoe Mfg. Co., North Main St., is having plans prepared by Tuck & Gilman, Archts., 34 School St., Boston, for the construction of a 3 story, 50 x 170 ft. shoe factory. Estimated cost, $125,000

Mass., Cambridge—The Johnson Educator Food Co., 40 Broad St., will receive bids until June 30 for the construction of a 3 story, 62 x 152 ft. factory. Estimated cost, $100,000. Webster & Libby 534 Congress St., Portland, Me., Archts. and Engrs.

Conn., Hartford—The Home Tourist Candy Co., c/o Backoff, Jones & Cook, Archts. Union Bldg., Newark, N. J., is having plans prepared for the construction of a 2 story, 60 x 100 ft. factory. Estimated cost, $50,000.

Conn., Stamford—The Yale & Towne Mfg. Co., 708 Pacific St., has awarded the contract for the construction of a 1 story, 27 x 100 ft. and a 17 x 23 ft. addition to its factory for the manufacture of hardware. Estimated cost, $20,000.

R. I., Woonsocket—The Amer. Wringer Co., 91 Social St., will soon award the contract for the construction of additions to its plant, to include a 1 story, 80 x 100 ft. dry kiln, a 1 story, 60 x 186 ft. mechanical roll building and a 3 story, 40 x 90 ft. warehouse addition. Estimated cost, $100,000. Noted May 20. Cooley & Marvin Co., 711 Tremont Bldg., Boston, Engrs.

Vt., West Rutland—The Vermont Marble Co. has awarded the contract for the construction of a 2 story, 100 x 330 ft. factory. Estimated cost, $225,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Maryland Color Printing Co., Holliday and Hillen Sts., has awarded the contract for the construction of a 1 story, 100 x 110 x 135 ft. plant. Estimated cost, $2,000,000.

Md., Cumberland—The Kelley Springfield Tire Co., River Rd., has awarded the contract for the construction of a 3 and 4 story, 575 x 620 ft. rubber tire plant. Estimated cost, $2,000,000. Noted May 13.

N. J., Newark—The Bd. Educ., City Hall, will soon award the contract for the construction of a 3 story, 219 x 222 ft. school on 1st and 2nd Sts., to include a manual training department. Estimated cost, $1,125,000. J. Wilson and C. Ely, Firemens Trust Bldg., Archts.

N. J., Trenton—The Thermold Rubber Co., Whitehead Rd., has awarded the contract for the construction of a 2 story, 81 x 201 ft. rubber factory. Estimated cost, $175,000.

N. Y., Battle Island (Fulton P. O.)—The Arrowhead Paper Mills Co. has awarded the contract for the construction of a 2 story, 160 x 200 ft. addition at its plant. Estimated cost, $200,000.

N. Y., Glens Falls—R. S. Clark, Saratoga, is building a 1 story silk mill on Clinton Ave., here. Estimated cost, $275,000.

N. Y., Hudson Falls—The Union Bag and Paper Co., has awarded the contract for the construction of a 4 story, 93 x 390 ft. bag mill. Estimated cost, $700,000.

N. Y., Mount Vernon—Armour & Co., Union Stock Yards, Chicago, will soon award the contract for the construction of a 5 story packing plant, here.

N. Y., Niagara Falls—The Internatl. Paper Co., Buffalo Ave. and 13th St., has had plans prepared for the construction of an addition to its factory. Estimated cost, $65,000.

N. Y., Niagara Falls—The Kimberly Clark Paper Co., Pine St. and Packard Rd., has awarded the contract for the construction of a 2 story 145 x 458 ft. factory. Estimated cost, $700,000.

N. Y., Niagara Falls—The Natl. Carbon Co. College Ave., has awarded the contract for the construction of a 1 story, 25 x 300 ft. factory. Estimated cost, $100,000.

N. Y., Niagara Falls—The Paper Convertible Corp. has awarded the contract for the construction of a 2 story, 105 x 375 ft. factory. Estimated cost, $300,000.

N. Y., New York (Borough of Brooklyn)—The General Laundry, Inc., c/o Shampan & Shampan, Archts., 50 Court St., will build a 4 story, 40 x 100 ft. laundry at 835 Myrtle Ave. Estimated cost, $150,000.

N. Y., New York (Borough of Brooklyn)—The Knitwear Mfg. Co., 114 5th Ave., New York City, will build a 4 story, 90 x 100 ft. factory on Jefferson Ave., here. Estimated cost, $150,000.

N. Y., New York (Borough of Brooklyn)—The New York Pie Baking Co., 82 Sullivan St., New York City, is having plans prepared by Ballinger & Perrott, Archts. and Engrs., 47 West 34th St., New York City, for the construction of a bakery on Nevins and Butler Sts., here. Estimated cost, $200,000.

N. Y., New York (Borough of Brooklyn)—The West End Wet Wash Laundry, 7114 17th Ave., will build a laundry. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—Valentine & Co., 346 Manhattan Ave., has awarded the contract for the construction of a factory on Richardson, Bayard and Lorimer Sts., for the manufacture of paints. Estimated cost, $50,000.

N. Y., New York (Borough of Manhattan)—W. Zinsser, 195 William St., will soon award the contract for the construction of a 4 story, 50 x 50 ft. factory on West 58th St., for the manufacture of paints. Estimated cost, $50,000. M. B. Schmidt, 14 East 40th St., Engr. and Archt.

N. Y., New York (Borough of Queens)—The Drug Products Co., 48 West 4th St., New York City, has awarded the contract for the construction of a 1 story factory and laboratory on Jackson and Pierson Aves., Long Island City. Estimated cost, $175,000.

Pa., Philadelphia—The Yarnall Paint Co., 1026 Race St., has awarded the contract for alterations to its factory. Estimated cost, $30,000.

SOUTHERN STATES

Fla., Palatka—The McGuire Fertilizer Co., Morriston, will build a fertilizer mixing plant, near here. Estimated cost, $200,000.

N. C., Nevassa—The Morris Fertilizer Co., Citizen and Southern Bank Bldg., Atlanta, Ga., has awarded the contract for the construction of a fertilizer factory, here.

N. C., Winston-Salem—The O'Brien Knitting Co. plans to build several mills in nearby towns.

MIDDLE WEST

Mich., Charlotte—The Charlotte Chair Co. has awarded the contract for the construction of a 2 story, 48 x 95 ft. and a 1 story, 28 x 60 ft. addition to its factory for the manufacture of furniture. Estimated cost, $30,000. Noted May 13.

Mich., Detroit—The Detroit Graphite Co., 12th St., is having plans prepared by Smith, Hinchman & Grylls, Archts., 710 Washington Arcade Bldg., for the construction of a 2 story factory for the manufacture of paint. Estimated cost, $50,000.

Mich., Kalamazoo—The Sutherland Paper Co., Lincoln St., has awarded the contract for the construction of a 3 story, 96 x 375 ft. paper mill.

Mich., Port Huron—The Womans Benefit Association, Military and Chestnut Sts., is having plans prepared by Schmidt, Gardner & Martin, Archts., 104 South Michigan St., Chicago, for the construction of a 40 x 113 ft. addition, to include a printing room. Estimated cost, $100,000.

O., Cincinnati—The Fitch Dustdown Co., 1028 West Front St., has awarded the contract for the construction of a 1 story, 80 x 100 ft. dustdown factory on Brownway and Verne Sts. Estimated cost, $8,000.

O., Cleveland—The Kaase Bakery Co., 2836 Lorain Ave., has awarded the contract for the construction of a 2 story commercial building and bakery. Estimated cost, $100,000.

O., Columbus—The Climax Rubber Co., Citizens Bank Bldg., will build a 2 story, 140 x 190 ft. rubber plant and a 2 story, 40 x 55 ft. office building and power plant. Noted Mar. 11.

O., Cuyahoga Falls—The Falls Rubber Co., has awarded the contract for the construction of a 3 story 61 x 84 ft. addition to its factory. Estimated cost, $60,000. Noted May 13.

Wis., Carrollville—The U. S. Fertilizer Co. will soon award the contract for the construction of a 1 story, 100 x 100 ft. fertilizer plant. H. J. Esser, Camp Bldg., Milwaukee, Archt.

Wis., Sheboygan—The Ke-No Co., c/o G. Webelock, plans to remodel its present factory and construct a 3 story, 60 x 120 ft. addition, on North Water St., for the manufacture of billiard equipment. Estimated cost, $30,000.

WEST OF THE MISSISSIPPI

Mo., St. Louis—The Amer. Bed Co., 1820 McNulty St., has awarded the contract for the construction of a 2 story, 75 x 130 ft. paint shop on Park Ave. Estimated cost, $30,000.

Tex., Corsicana—The Pioneer Hosiery Mills Co. plans to establish a hosiery mill, to have a daily capacity of 200 dozen pairs. B. Wofford and W. Clarkson Jr., 734 West 2nd Ave., are organizers.

Tex., Vernon—The Victor Pipe Line and Refining Co., Dixon Bldg. plans to build a 1 story oil refinery to have a daily capacity of 2,000 bbl. Estimated cost, $150,000. J. W. Hudson, Dir.

WESTERN STATES

Cal., El Segundo—The General Chemical Co., 25 Broad St., New York City, has awarded the contract for the construction of a factory here, for the manufacture of sulphuric acid. Estimated cost, $2,000,000.

Cal., Los Angeles—Wilson & Co., 1000 Lyon St., will build a factory for the manufacture of oleomargerine. Estimated cost, $100,000.

Cal., Riverbank—The Atchison, Topeka & Santa Fe Ry. Co., Ry. Exch. Bldg., Chicago, will build an ice plant here, to have a daily capacity of 1000 tons.

Cal., Sacramento—The California Almond Growers Assn., 311 California St., San Francisco, has awarded the contract for the construction of a 4 story almond shelling plant on 19th and C Sts., here. Estimated cost, $100,000

Cal., San Diego—The Citrus Soap Co. has awarded the contract for the construction of a 4 story factory on Union St., between Market and I Sts. Estimated cost, $100,000.

CANADA

Ont., Gananoque—The Eastern Ontario Milk Products Co., recently incorporated, plans to build a factory for the manufacture of condensed and evaporated milk. Cost between $100,000 and $150,000. Address L. P. Sherwood, Central Chambers, Ottawa.

Ont., London—The London Hosiery Co., Adelaide St., plans to build a 4 story addition to its factory. Estimated cost, $100,000.

Ont., New Hamburg—The Schierholtz Furniture Co., Arnold St., will build a 4 story, 50 x 65 ft. factory. Estimated cost, $50,000.

Ont., Seaforth—The Canada Flax Mills Co. plans to rebuild its mill which was recently destroyed by fire. Estimated cost, $30,000.

Que., Montreal—The Congoleum Co. of Canada has awarded the contract for the construction of a 70 x 118 ft. factory on St. Patrick St. Estimated cost, $105,000.

Que., Riviere du Loup—The Union Glove Wks., 683 Ontario St., Montreal, will soon award the contract for the construction of a 3 story, 50 x 110 ft. glove factory, here. Estimated cost, $100,000. M. C. Huart, St. Alexander St., Montreal, Mgr.

The Latest Opportunities

being offered in the machinery field
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SEARCHLIGHT SECTION

of this paper. See pages 393 to 426.